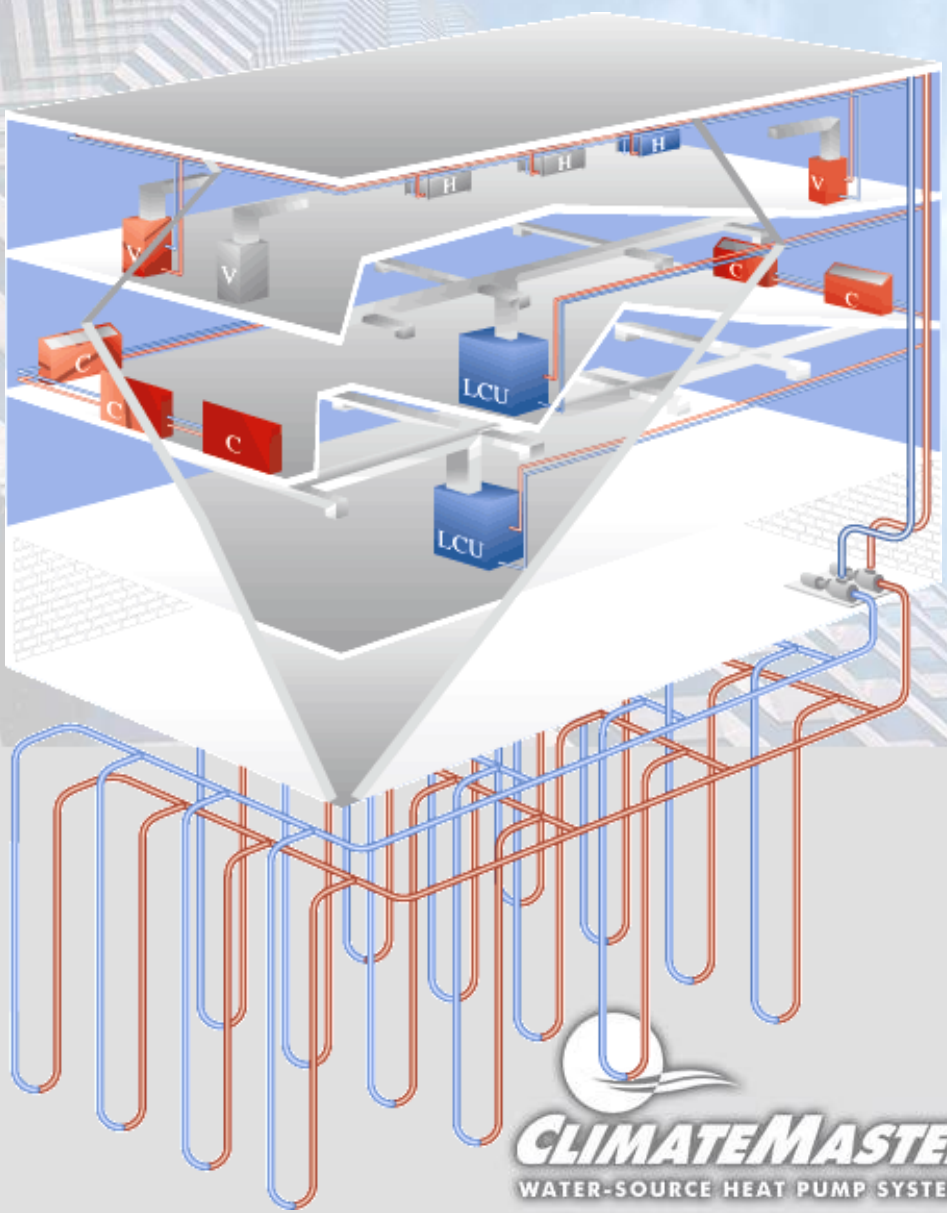
2011 IREC

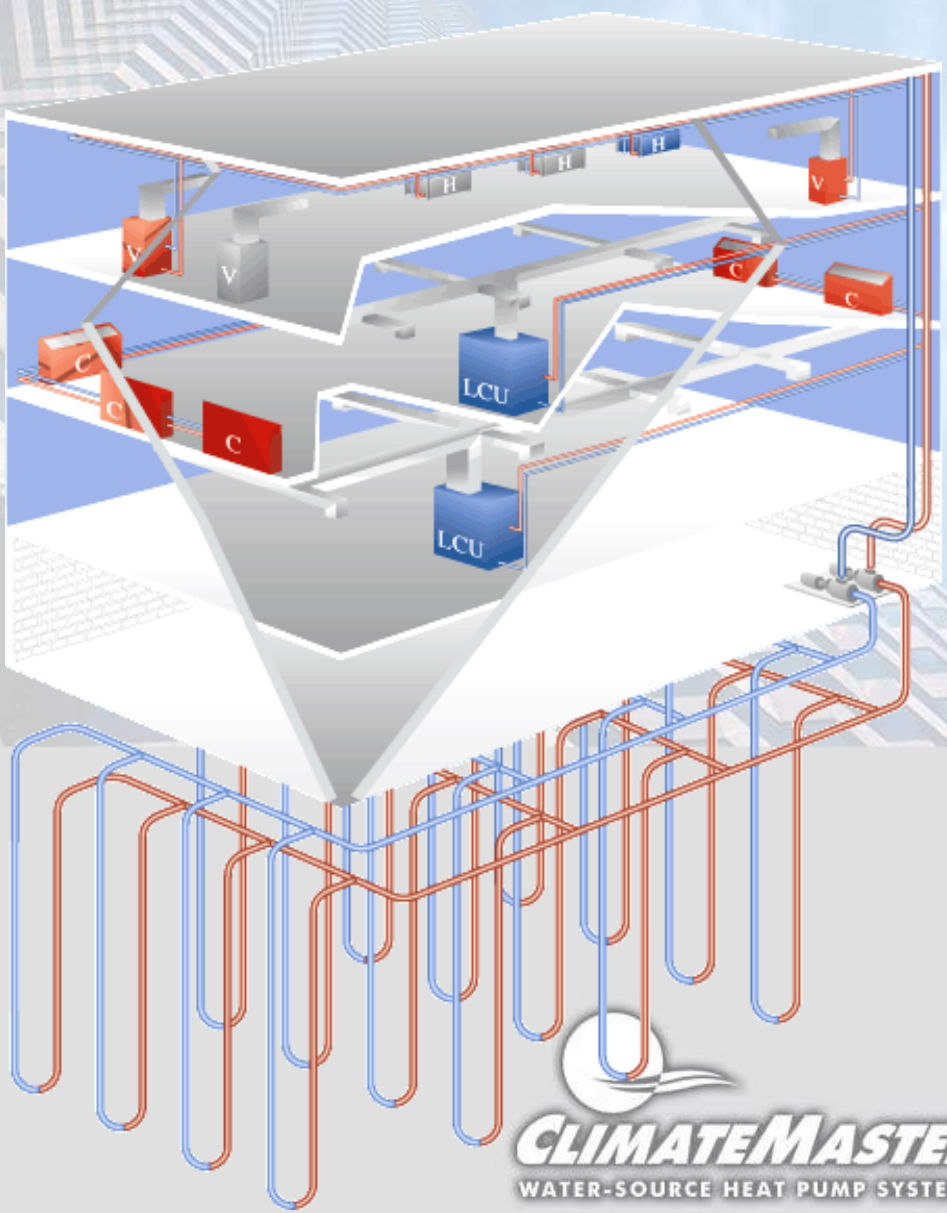
Geothermal Technology

Dennis Meyer
ClimateMaster



CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

Never forget the basics, when beginning commercial design…



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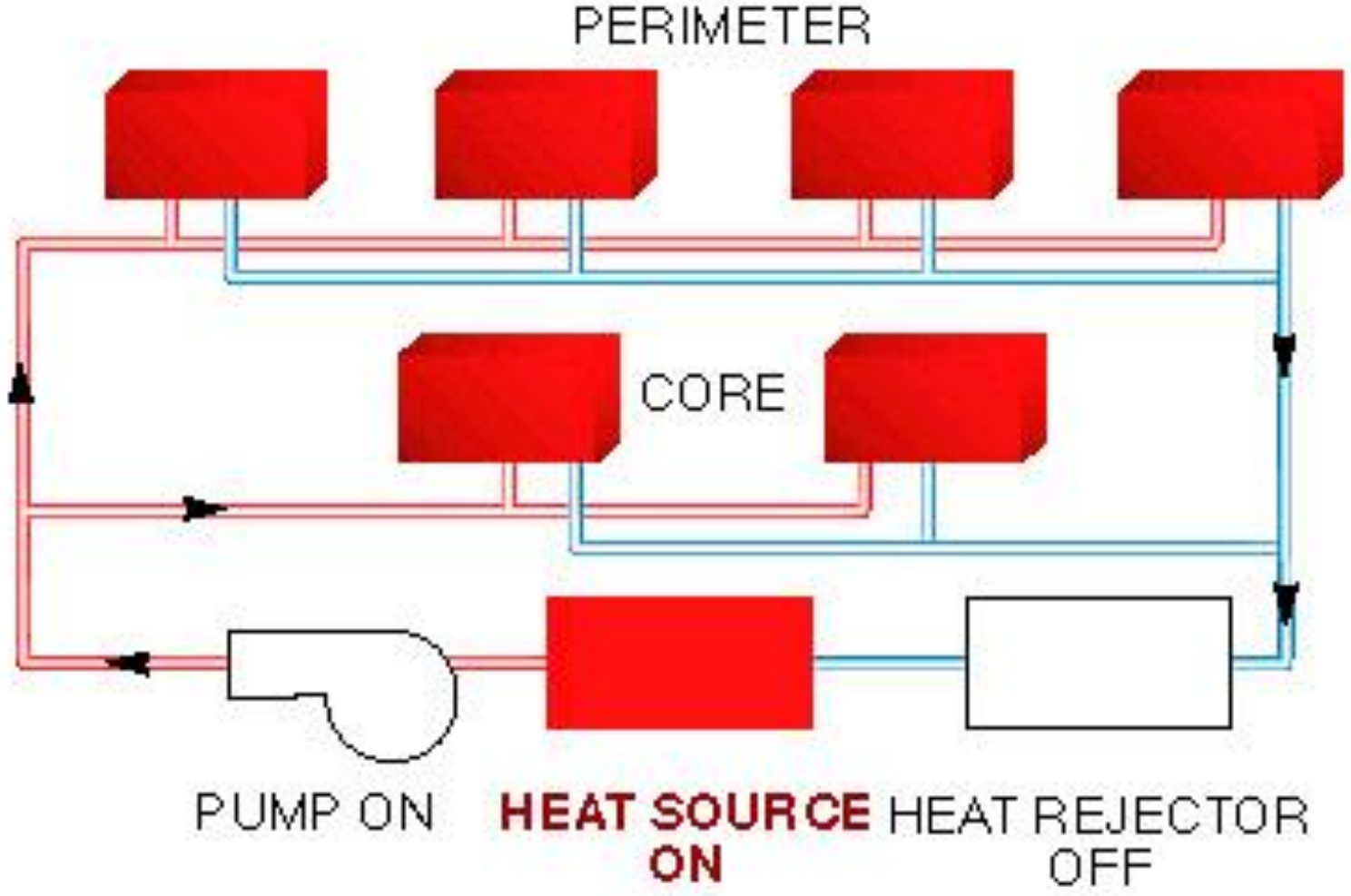
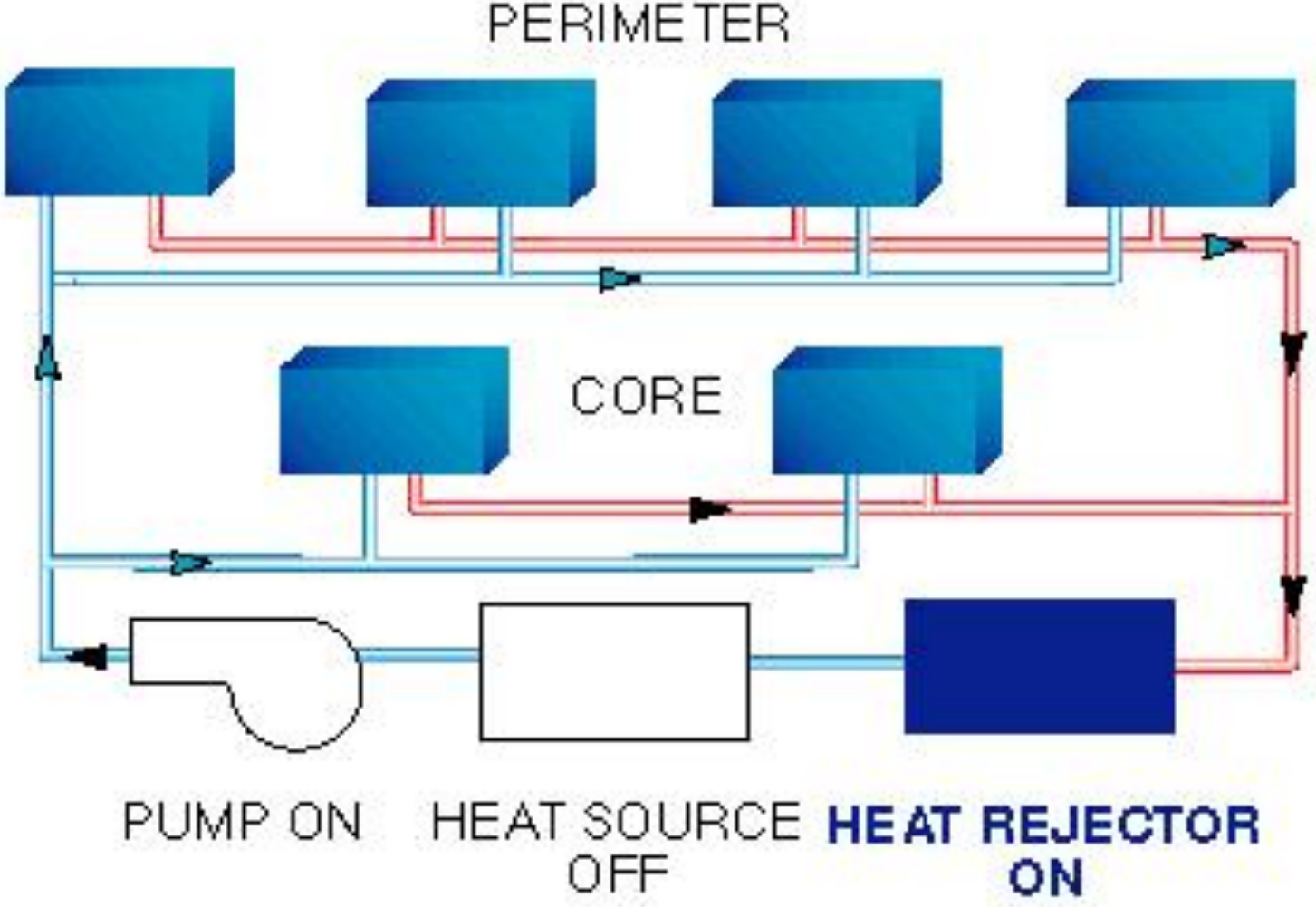
WATER-SOURCE HEAT PUMP SYSTEMS

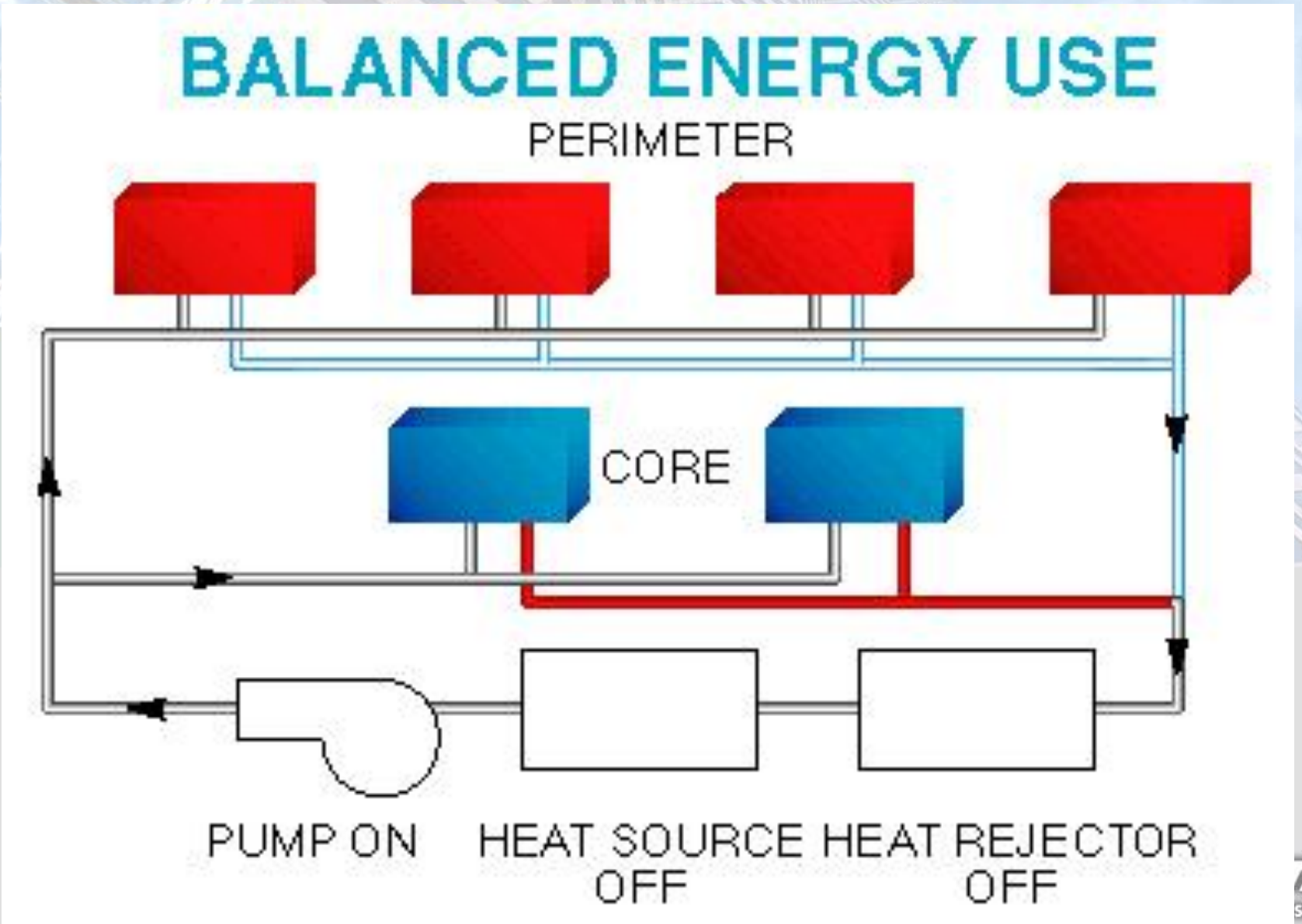
VERY COLD WEATHER



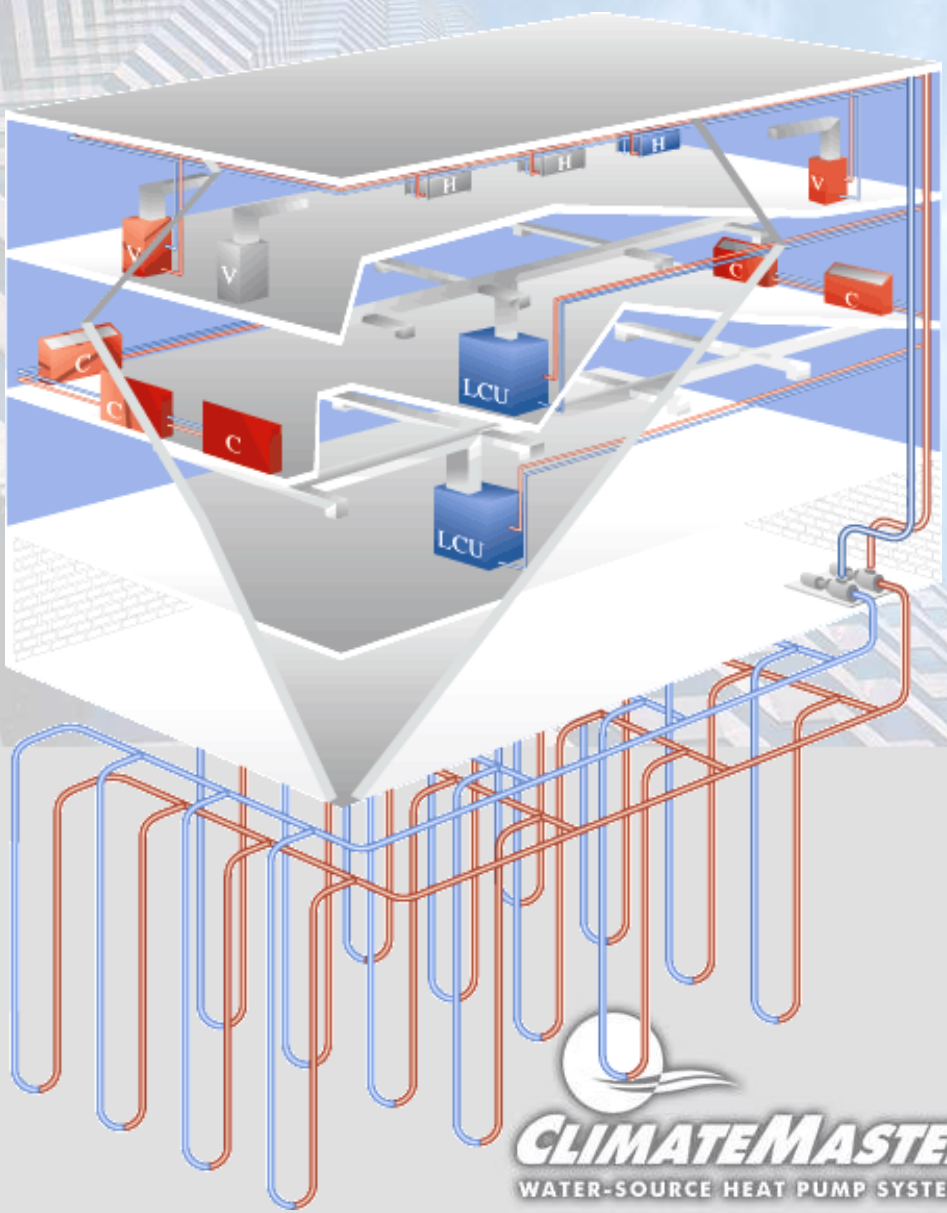
VERY HOT WEATHER



Utilize Load Diversity



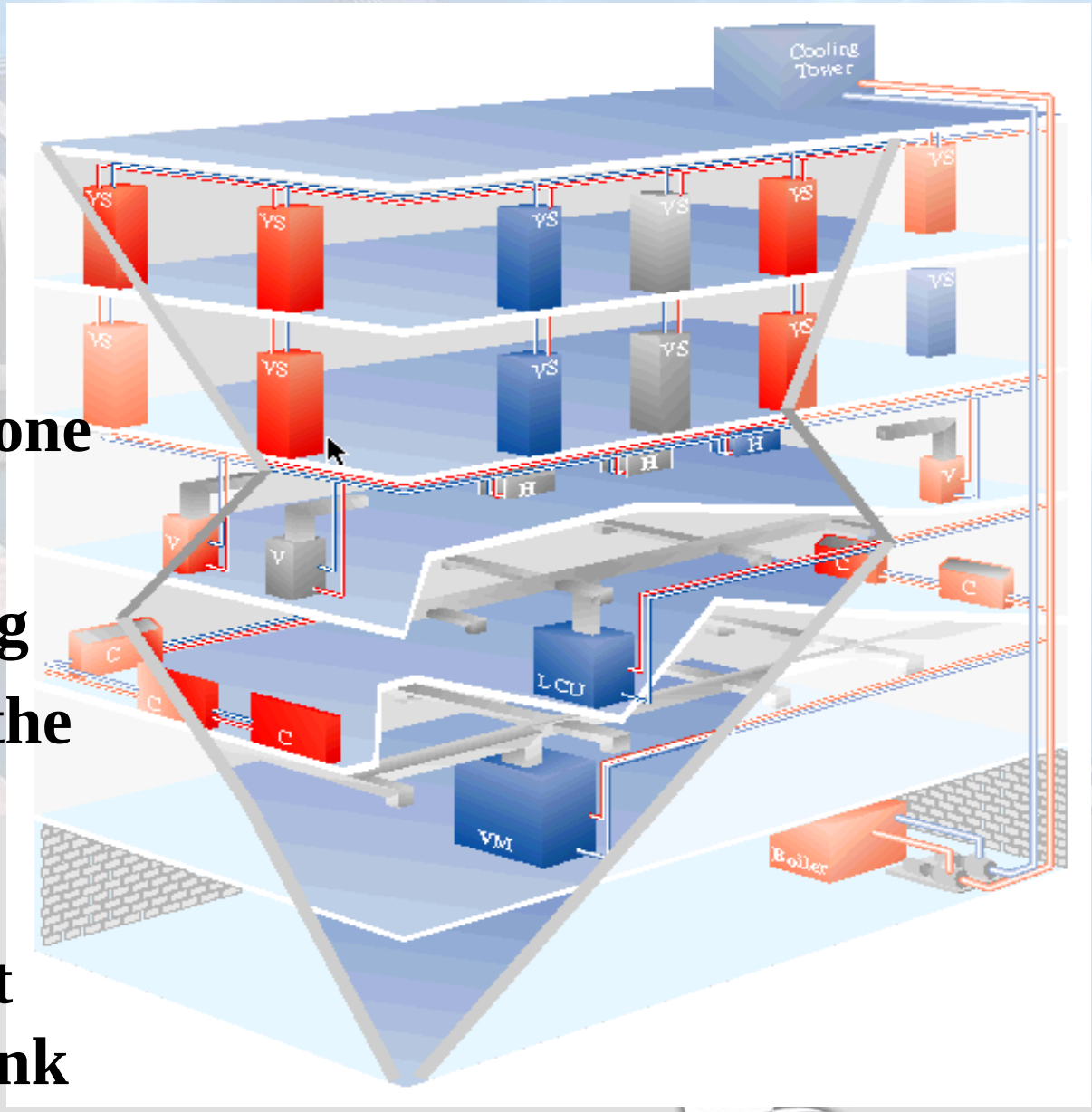
How are units applied?



CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

How Applied?

- Applied zone by zone
- ½ ton – 30 ton
- Heating or Cooling
- Water solution is the medium of heat transfer
- Need to select heat source and heat sink



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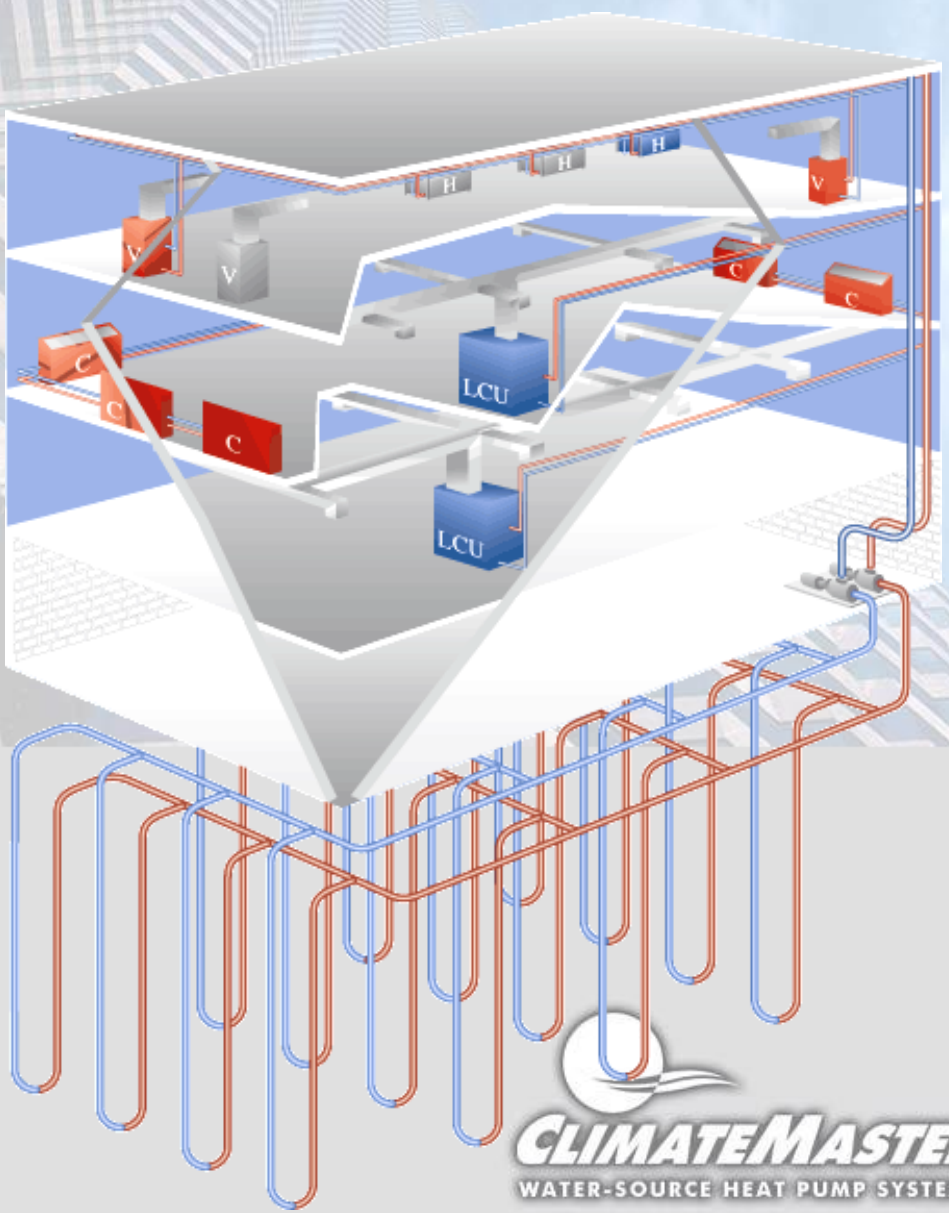
WATER-SOURCE HEAT PUMP SYSTEMS

Types of Heat Sinks & Heat Sources



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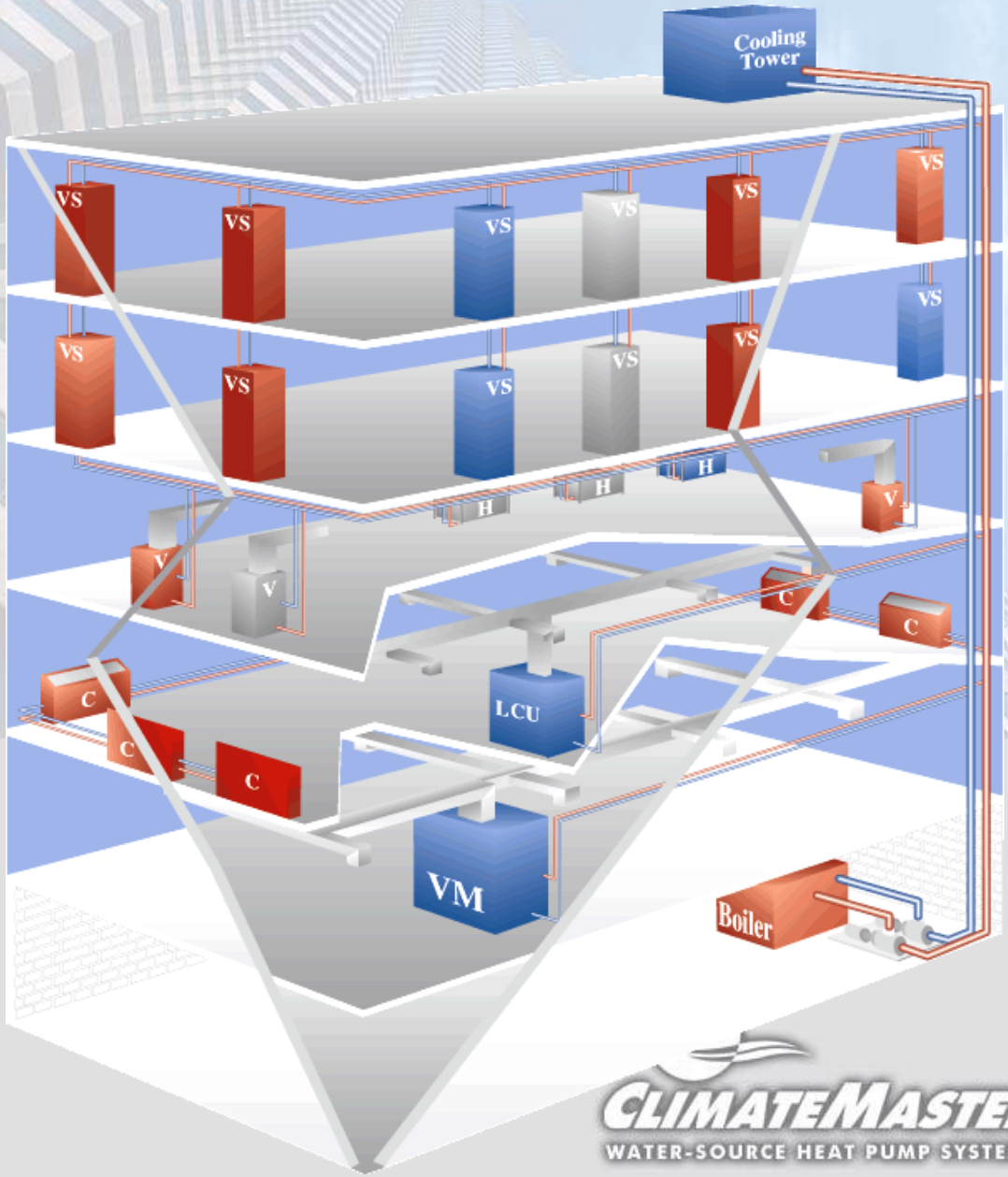
WATER-SOURCE HEAT PUMP SYSTEMS

Boiler/Tower Systems



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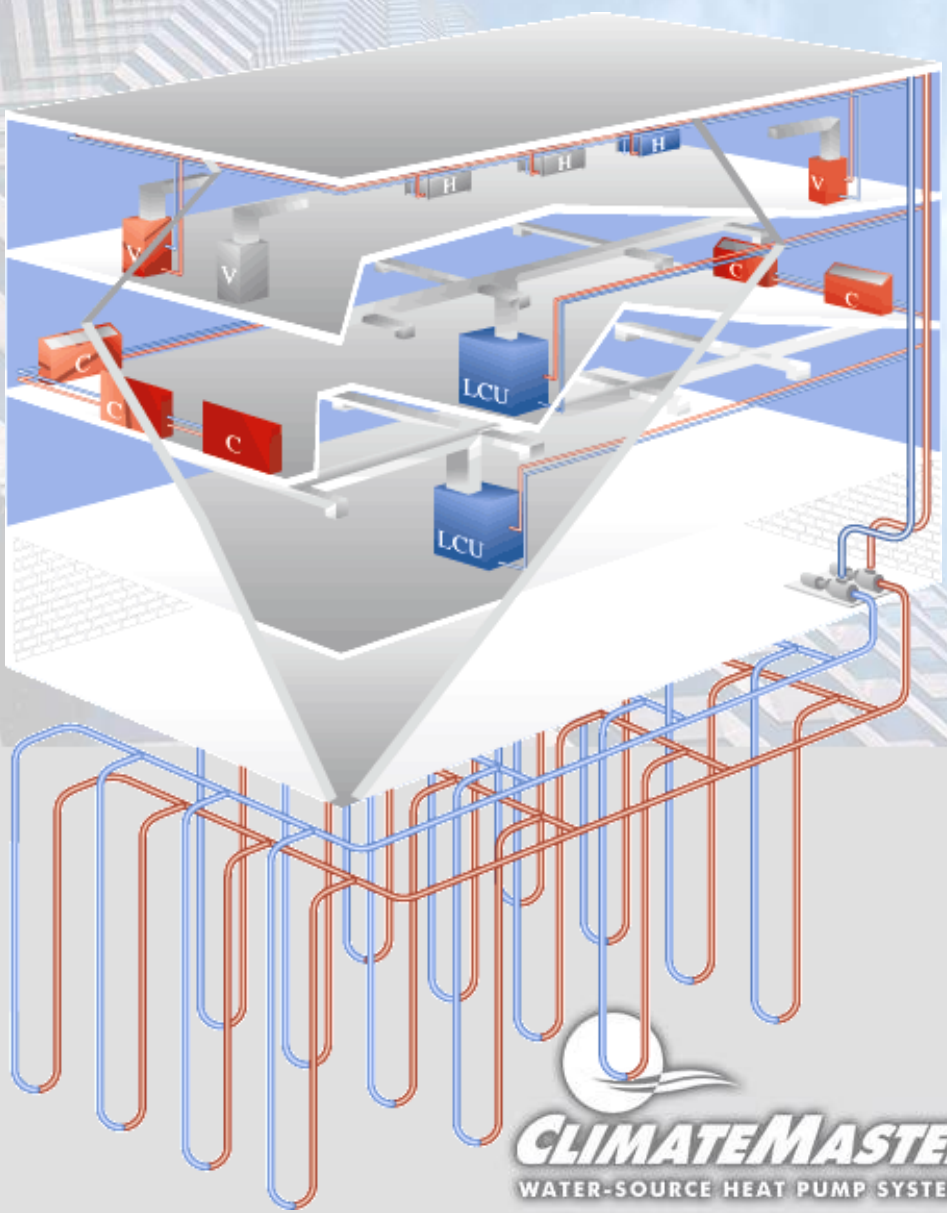
WATER-SOURCE HEAT PUMP SYSTEMS

Ground-Source (Geothermal)



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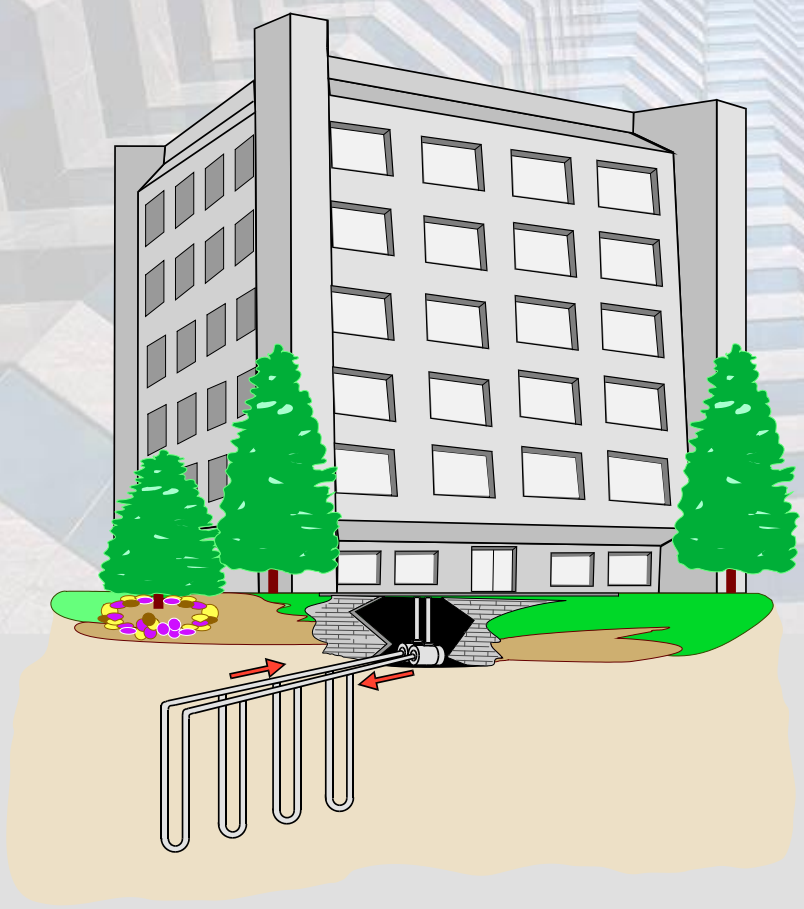
WATER-SOURCE HEAT PUMP SYSTEMS

Vertical Loop System



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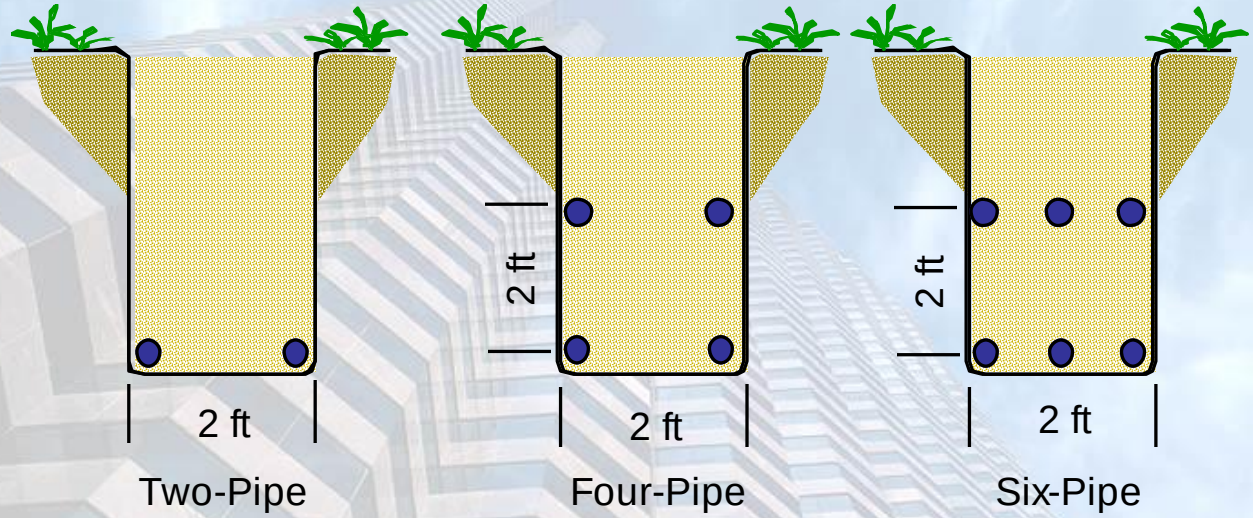
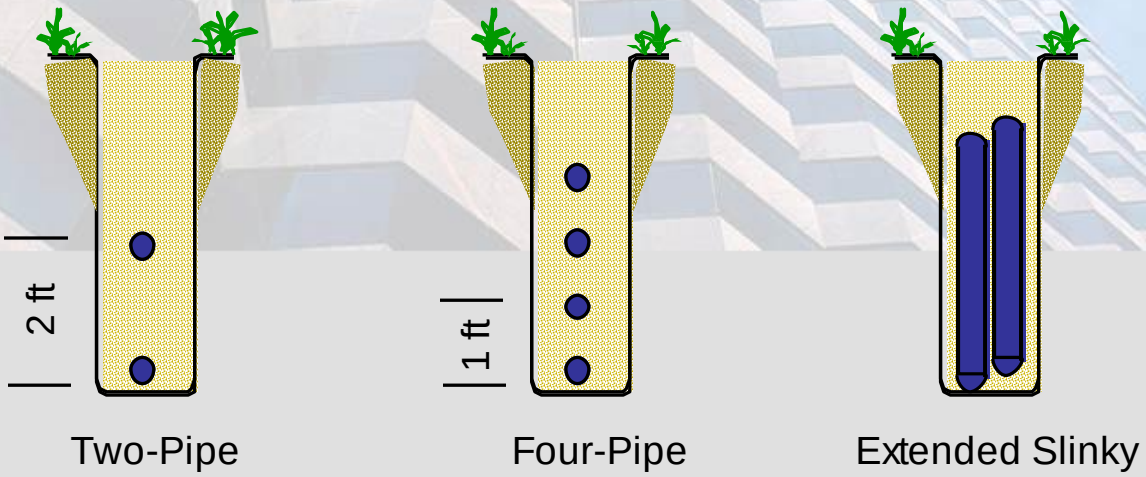
WATER-SOURCE HEAT PUMP SYSTEMS

Horizontal Loop Types



Back-Hoe Loops



Trenched Loops

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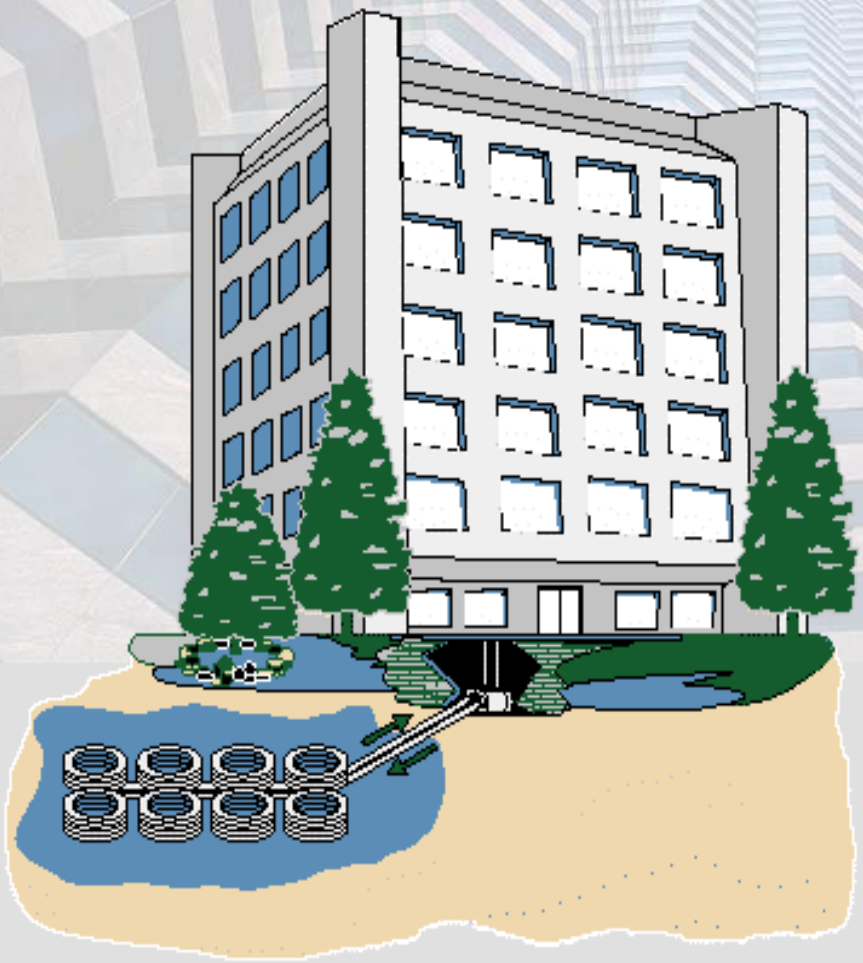
WATER-SOURCE HEAT PUMP SYSTEMS

Lake Loop System



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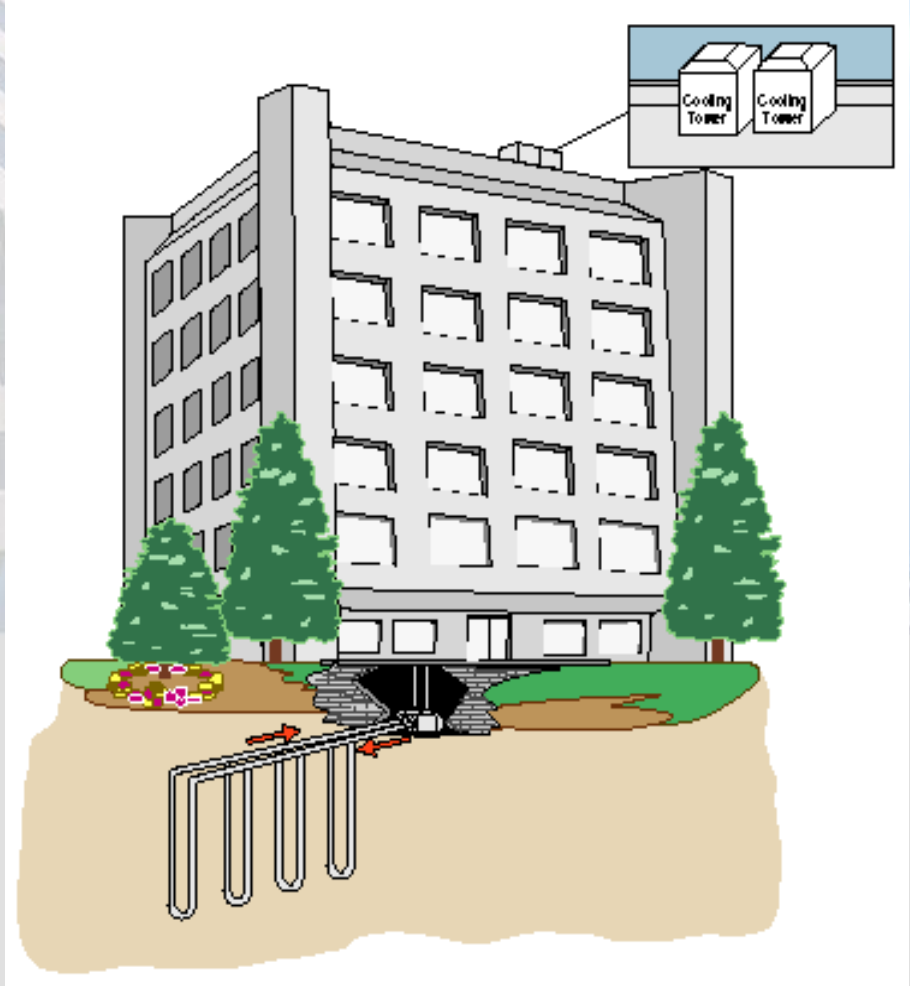
WATER-SOURCE HEAT PUMP SYSTEMS

Hybrid Systems

- **Ground Loop Used as Primary Sink and Source**
- **Fluid Cooler and/or Boiler used to supplement the Ground Loop**



CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

rts Menu

Geothermal Source

Source Type:	Vertical Closed Loop
Soil Type:	1.40 - Average Rock
Pipe Type:	3/4" IPS PE SDR 11
Pipe Configuration:	1 U-Tube in Bore
Avg Pipe Depth:	100 Feet
Bore Length:	5,000 Feet
Min Freeze Protect:	12 Deg F
Max Source-Cooling:	76 Deg F
Avg Source-Cooling:	55 Deg F
Avg Source-Heating:	38 Deg F
Min Source-Heating:	32 Deg F
Deep Earth Temp:	47 Deg F
Surface Swing:	20.2 Deg F

Average Eff
Annual Con
Annual Cost

- 25 ton building peak block load
- 200ft of bore per ton of load

Annual Cooling Cost:

Water Heating

Geothermal Hot Water G
Electrical Us
Average Eff

Geo A Summary Report | Print Screen | Print Options | Help | Zoom 200% | Done

rts Menu

Geothermal Source

Source Type:	Vertical Closed Loop
Soil Type:	1.40 - Average Rock
Pipe Type:	3/4" IPS PE SDR 11
Pipe Configuration:	1 U-Tube in Bore
Avg Pipe Depth:	150 Feet
Bore Length:	3,750 Feet
Min Freeze Protect:	8 Deg F
Max Source-Cooling:	89 Deg F
Avg Source-Cooling:	60 Deg F
Avg Source-Heating:	35 Deg F
Min Source-Heating:	28 Deg F
Deep Earth Temp:	47 Deg F

Average Eff
Annual Con
Annual Cost

- 25 ton building peak block load
- 150ft of bore per ton of load

Annual Cooling Cost:

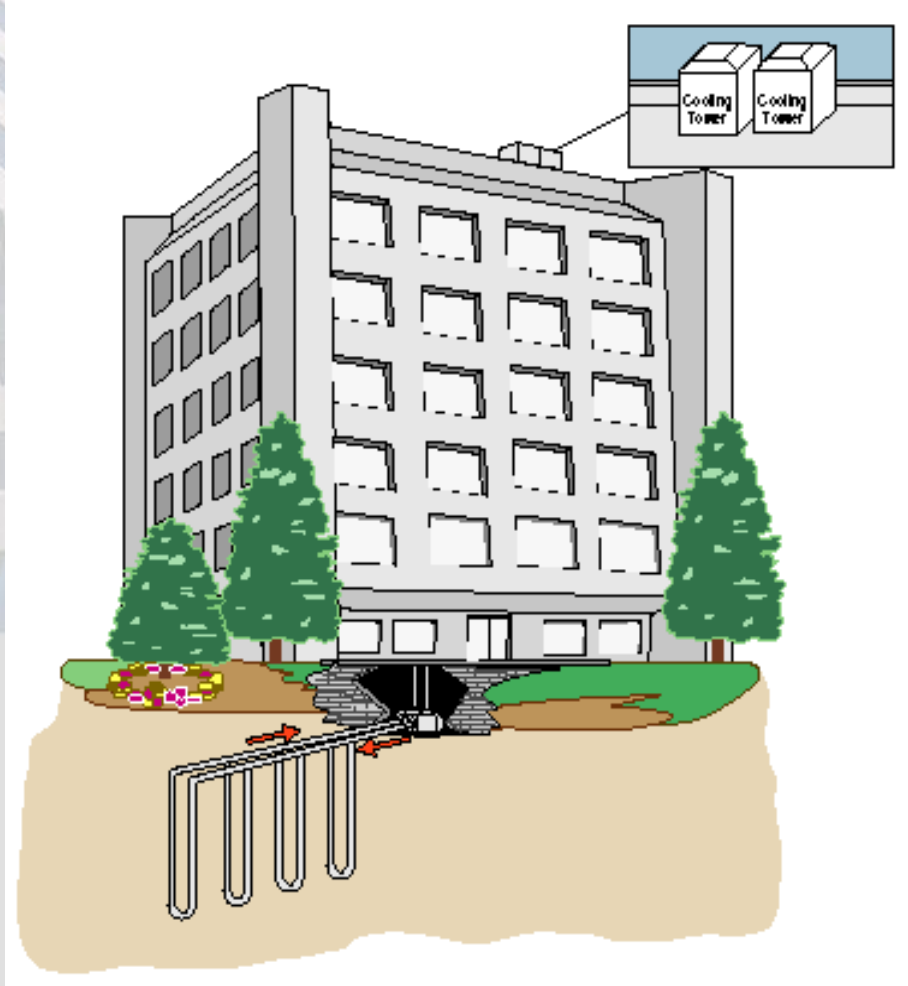
Water Heating

Geothermal Hot Water G
Electrical Us

Geo A Summary Report | Print Screen | Print Options | Help | Zoom 200% | Done

Hybrid Systems

- **Design loop to building peak block load…not to connected equipment**
- **25% reduction in geo loop**
- **Replace with lower cost fluid cooler**



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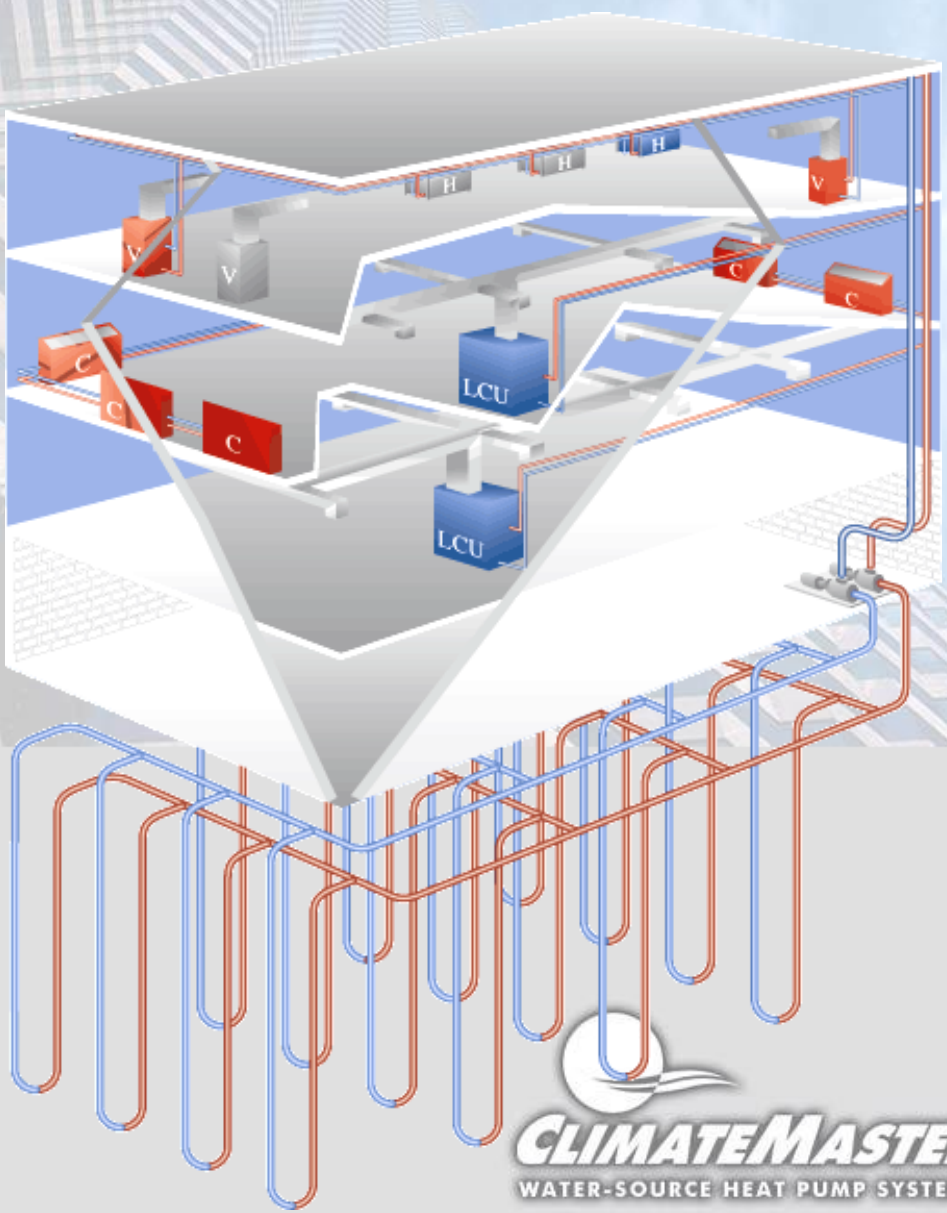
WATER-SOURCE HEAT PUMP SYSTEMS

Key Components



CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

Key Components

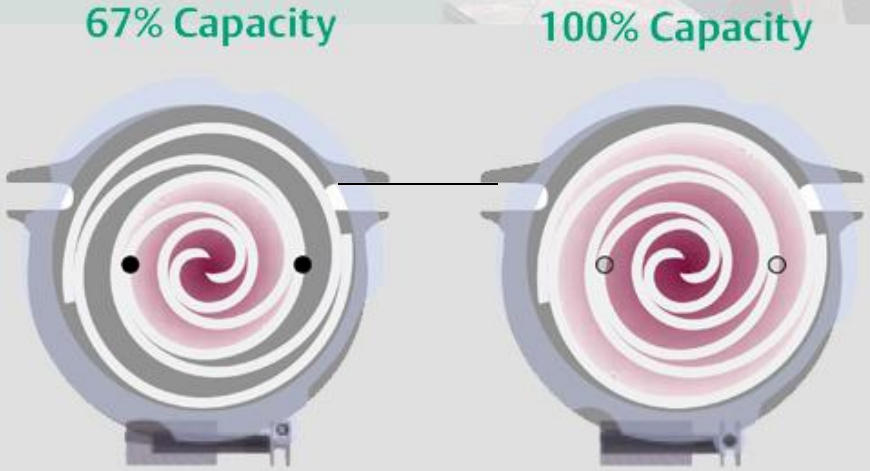
Variable speed ECM fan motor

Two-stage unloading scroll compressor

CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

Two-Stage Scroll Compressor

- Very high efficiencies at full load
- Ultra high efficiencies on part load
  - Unique “unloading” capability allows “shift on the fly”
  - 67% capacity satisfies load 80-90% of the time, increasing average efficiency



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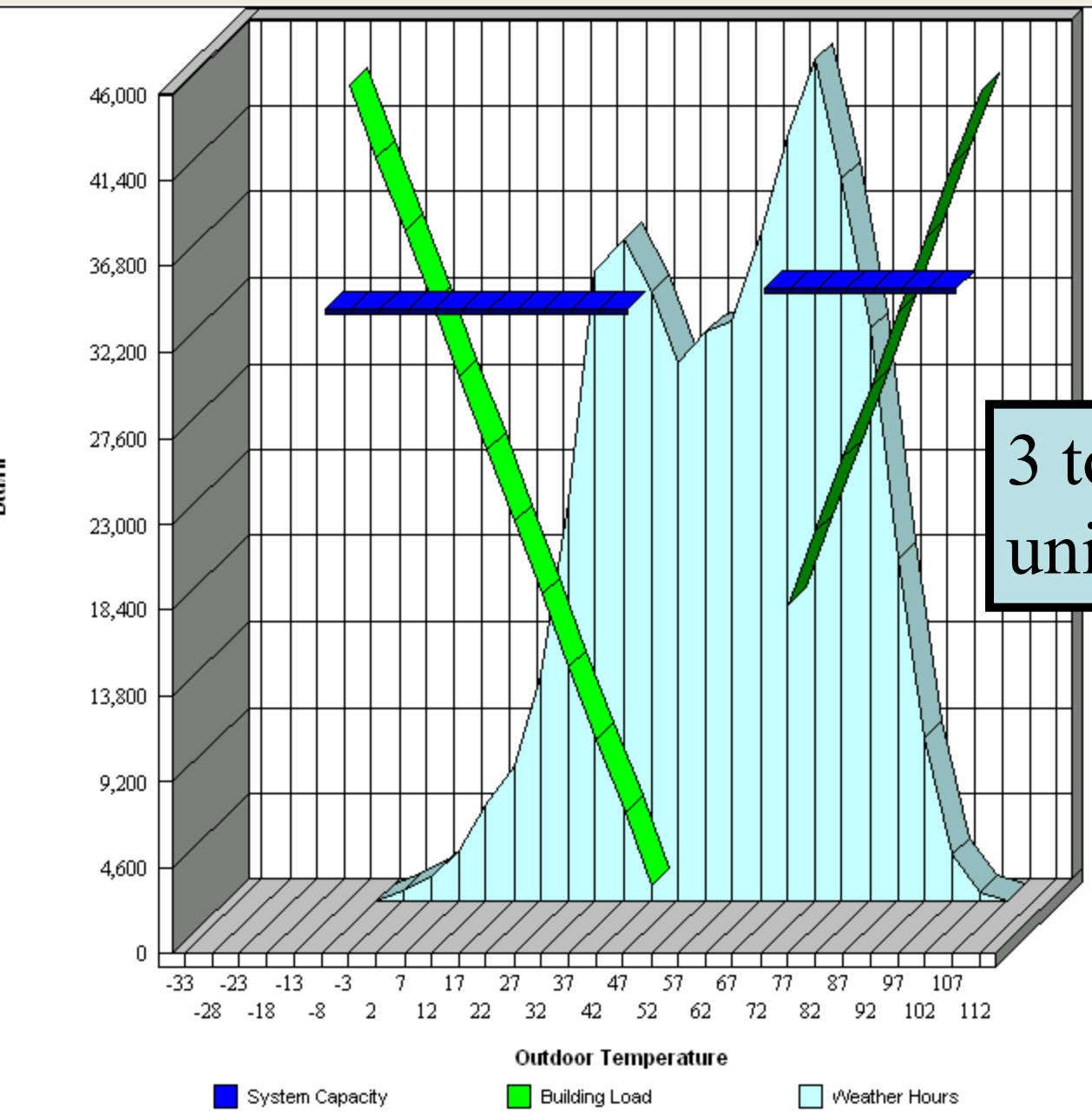
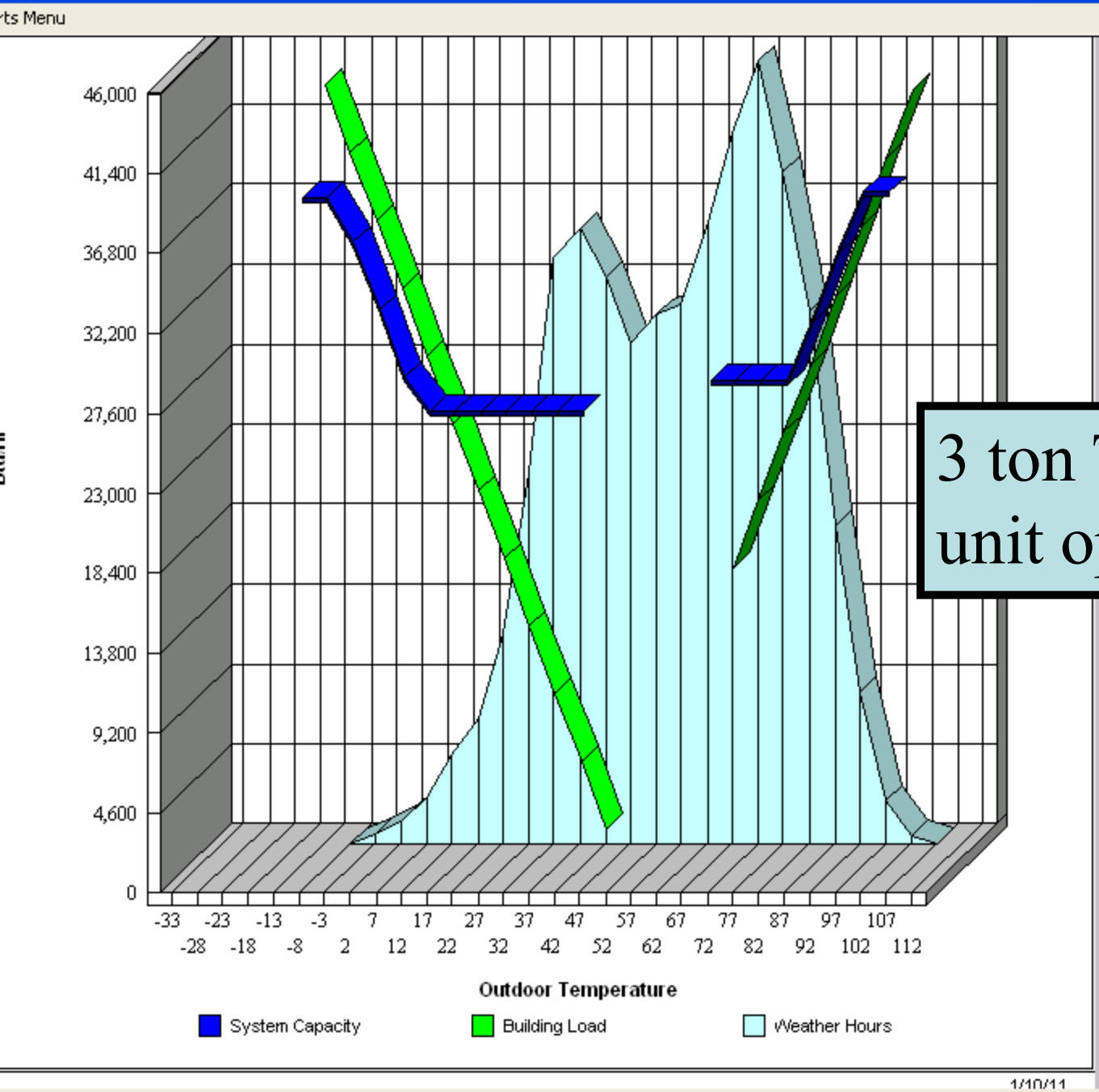
WATER-SOURCE HEAT PUMP SYSTEMS



3 ton single stage unit operation

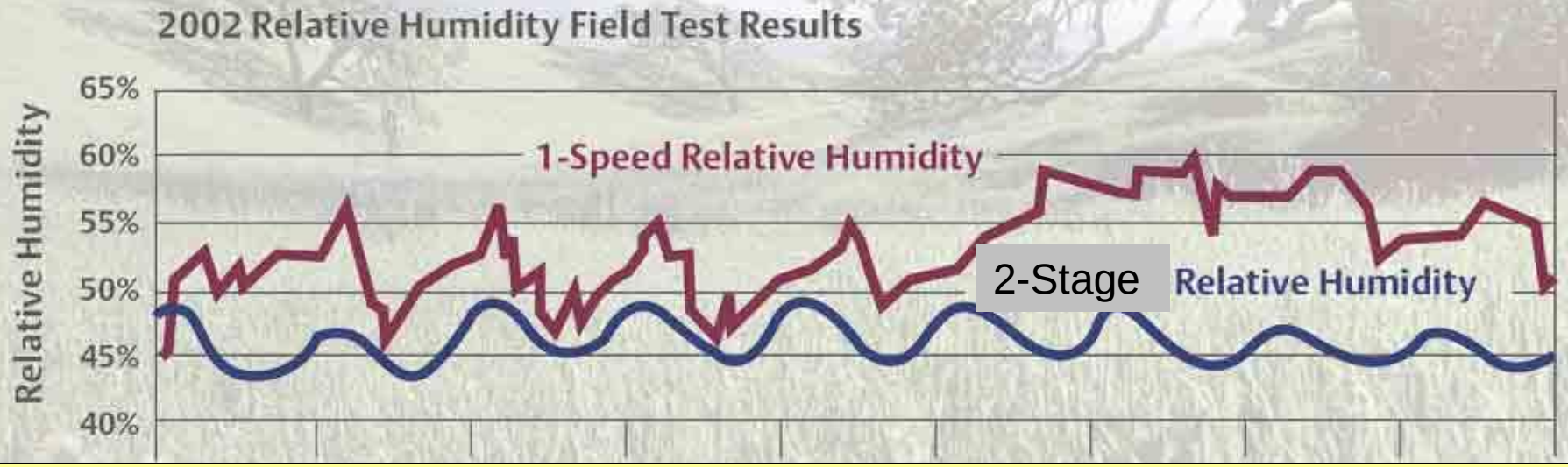


3 ton TWO stage unit operation

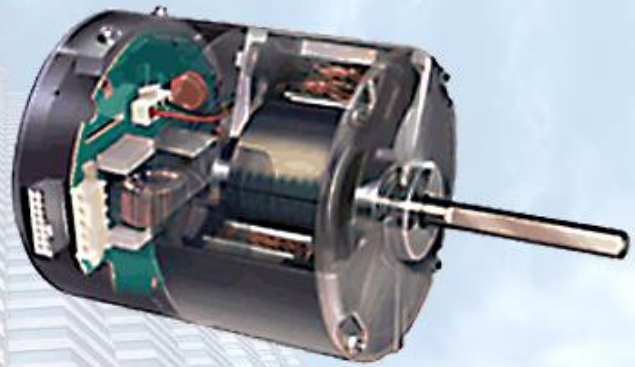
PCM0404290031

Two-Stage Compressor Benefits

Humidity Control



Variable Speed ECM Motor



- Lower fan Watts during high speed operation
- Even lower fan Watts during part load compressor operation
- Extremely low Watts for “fan only” -- typically 40-60 Watts
- Helps increase EER/COP

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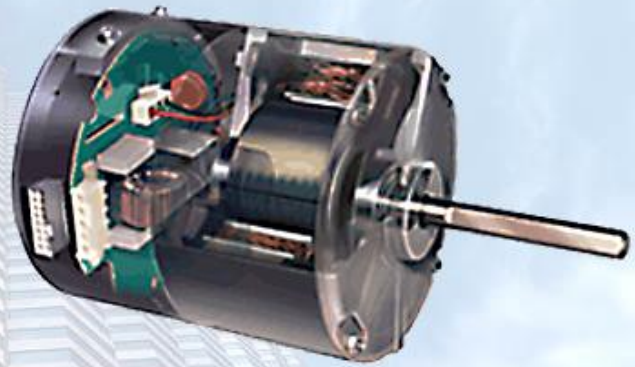
WATER-SOURCE HEAT PUMP SYSTEMS

Variable Speed ECM Motor



- Soft start
- Less air noise
- CFM flexibility allows zoning applications
- Fan speed regulation allows improved humidity control

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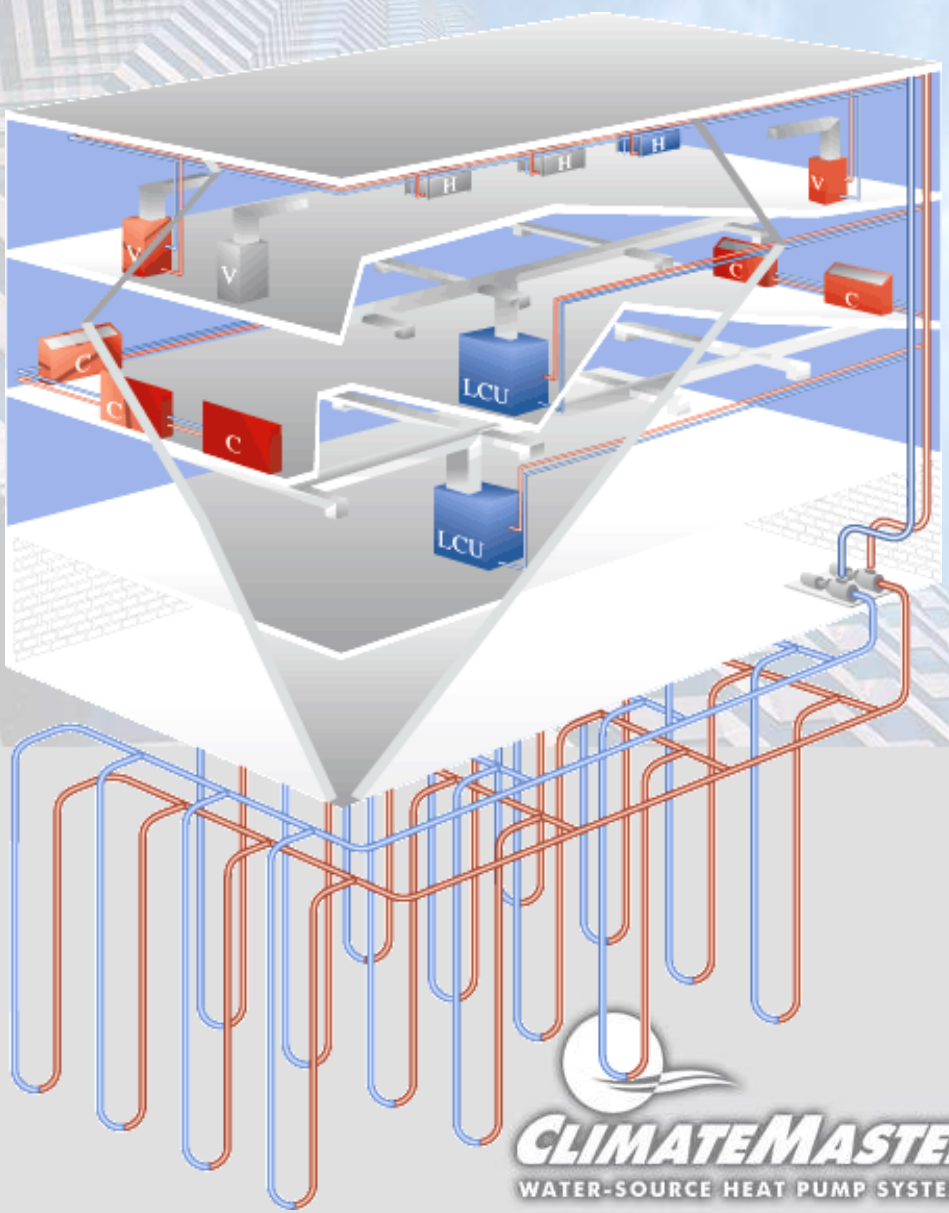
WATER-SOURCE HEAT PUMP SYSTEMS

Outside Air And Geothermal Heat Pumps



CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

Bring in “Neutral” OA Air to Bldg

- Mechanical Conditioning of Outside Air
  - Brings in “neutral” air to the space
  - Allows WSHPs to handle sensible loads and internal latent loads
  - Allows equipment to be downsized by 30-50% (depending upon location)
  - May reduce boiler/tower OR geothermal loop size, depending upon choice of Mechanical Equipment
  - Solves IAQ problems

CLIMATEMASTER®
WATER-SOURCE HEAT PUMP SYSTEMS

100% OA Units


HORIZONTAL UNIT

- 3 to 100 Tons
- ≈125 to 200cfm per Ton
- DewPoint control to 55F or below
- Entering Air down to 0F without wheel

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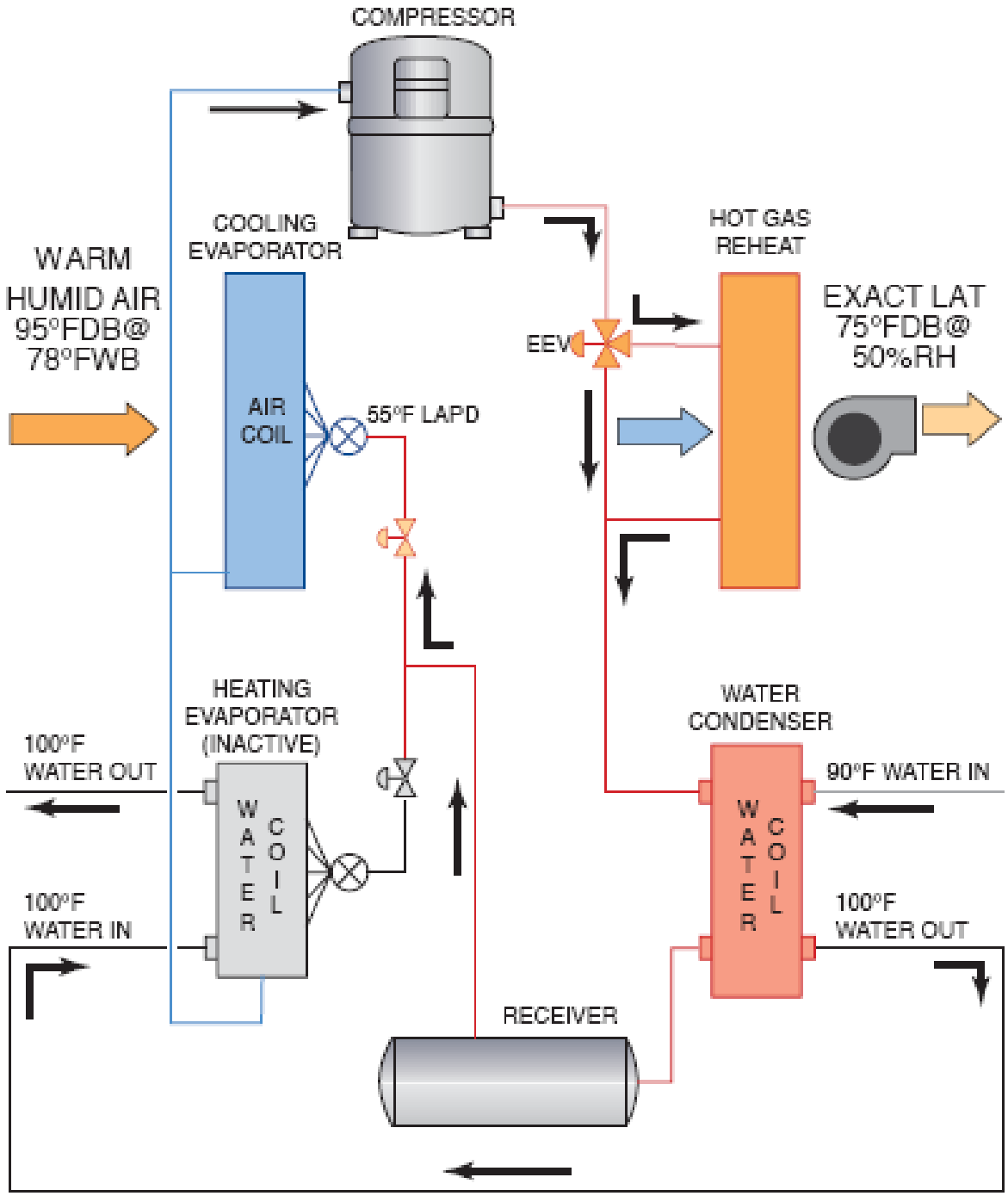
WATER-SOURCE HEAT PUMP SYSTEMS



Mechanical Conditioning of OA :

Summer Cooling Mode

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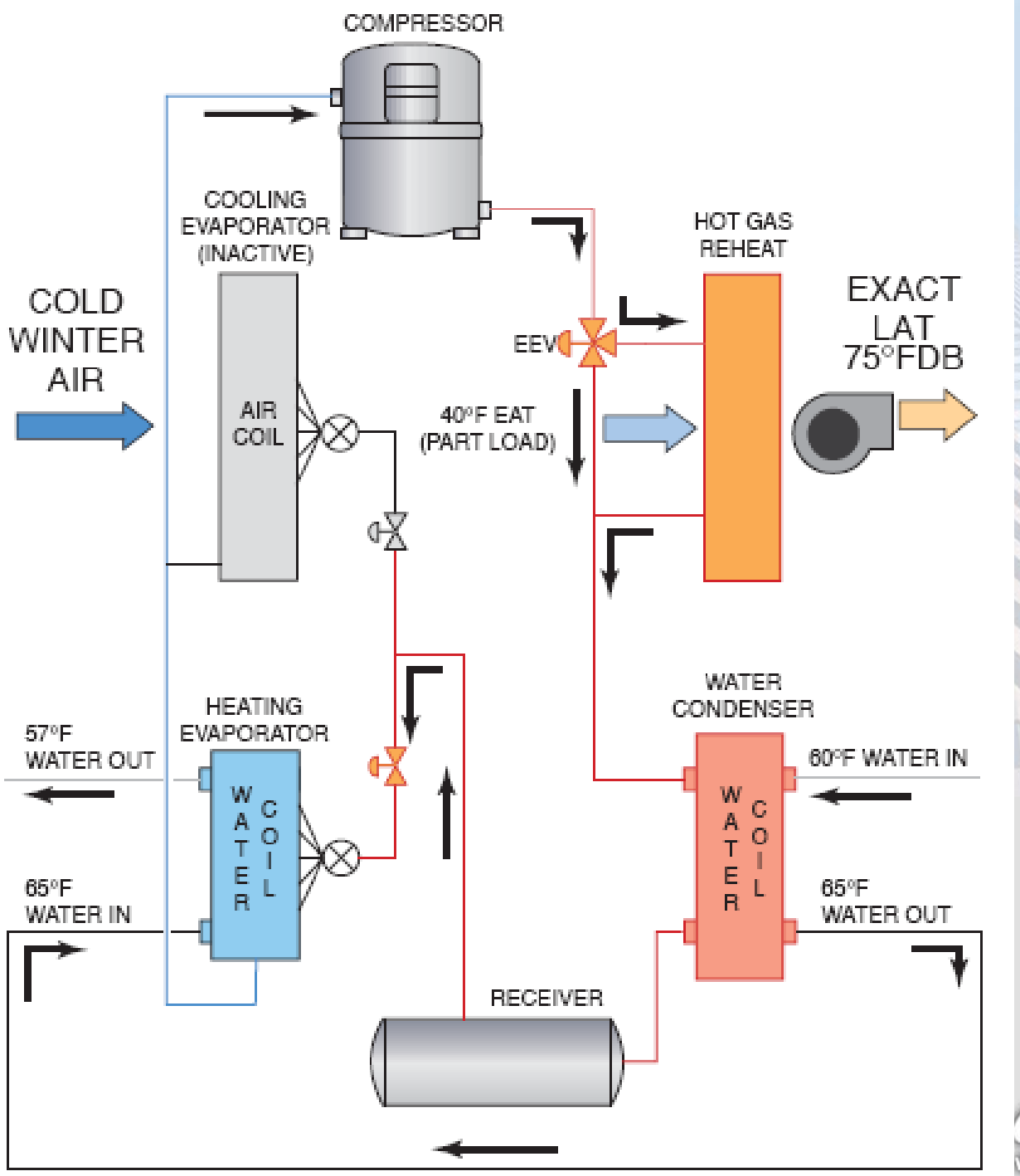

Mechanical Conditioning of OA:

Winter Heating Mode

ClimateMaster
WATER-SOURCE HEAT PUMP SYSTEMS

Figure 5: Energy Recovery Wheel Operation

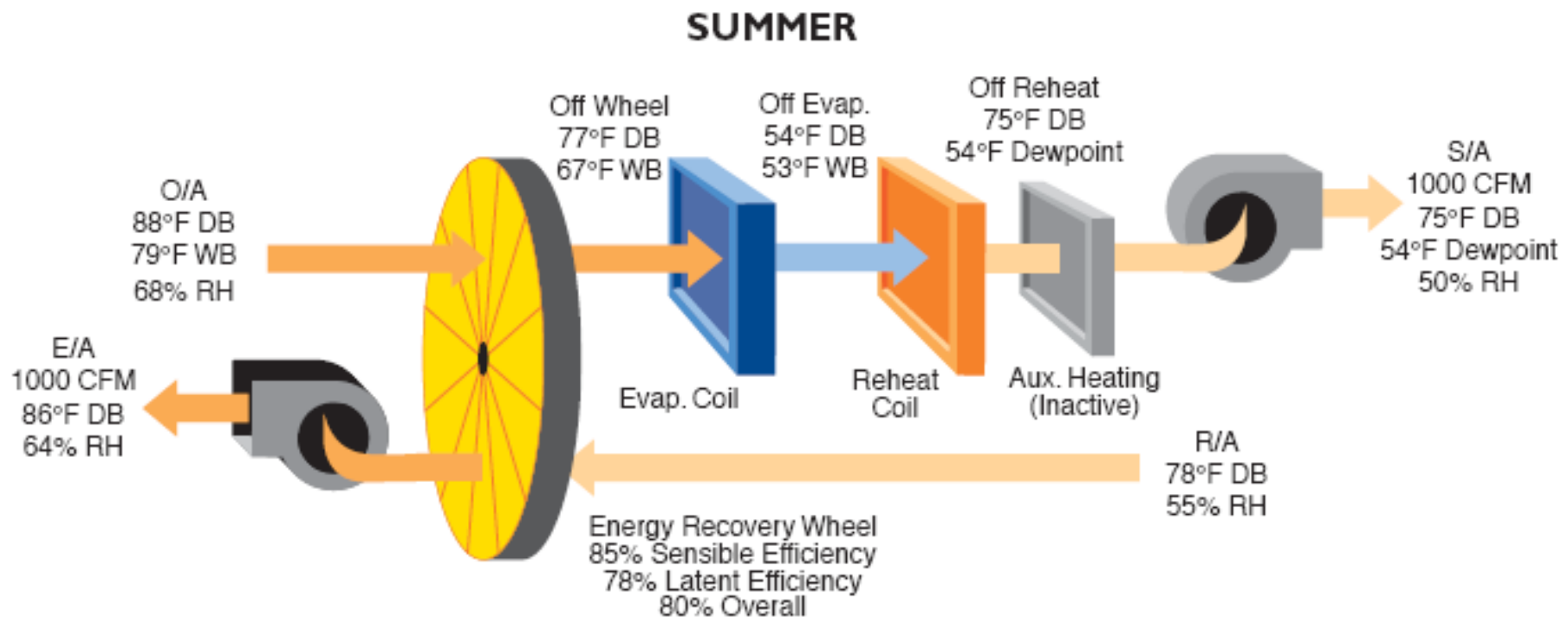

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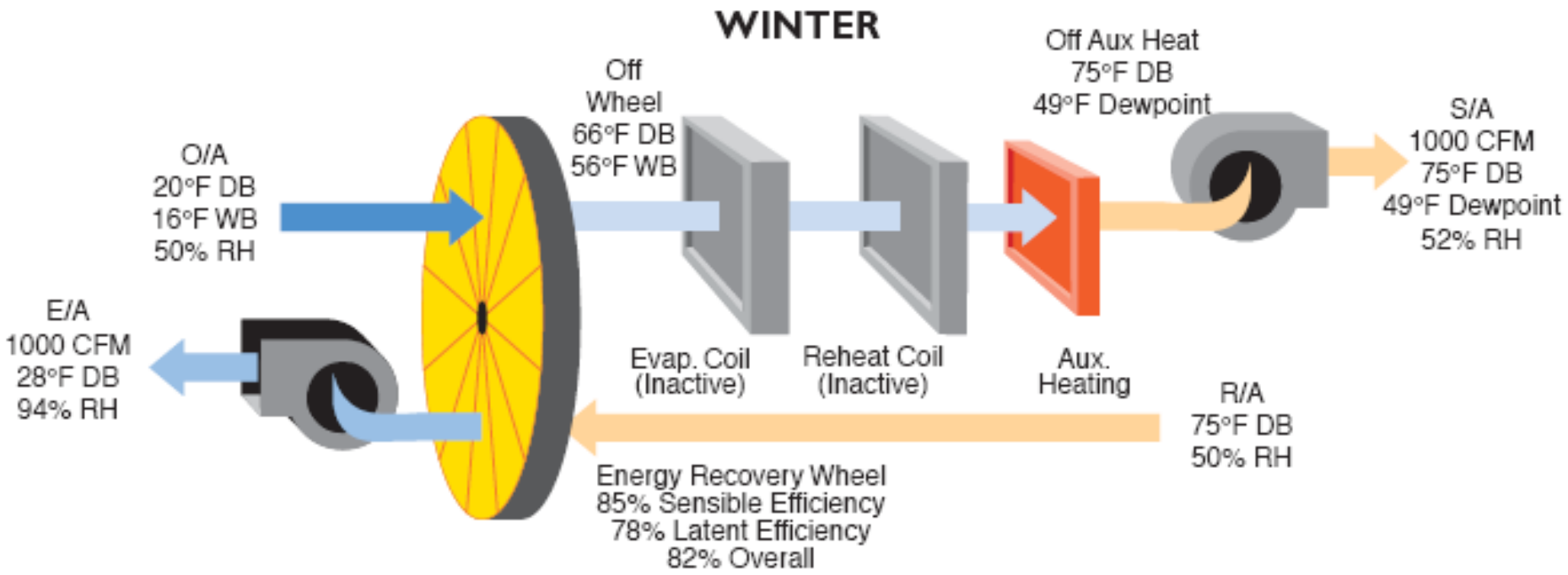
Figure 5: Energy Recovery Wheel Operation



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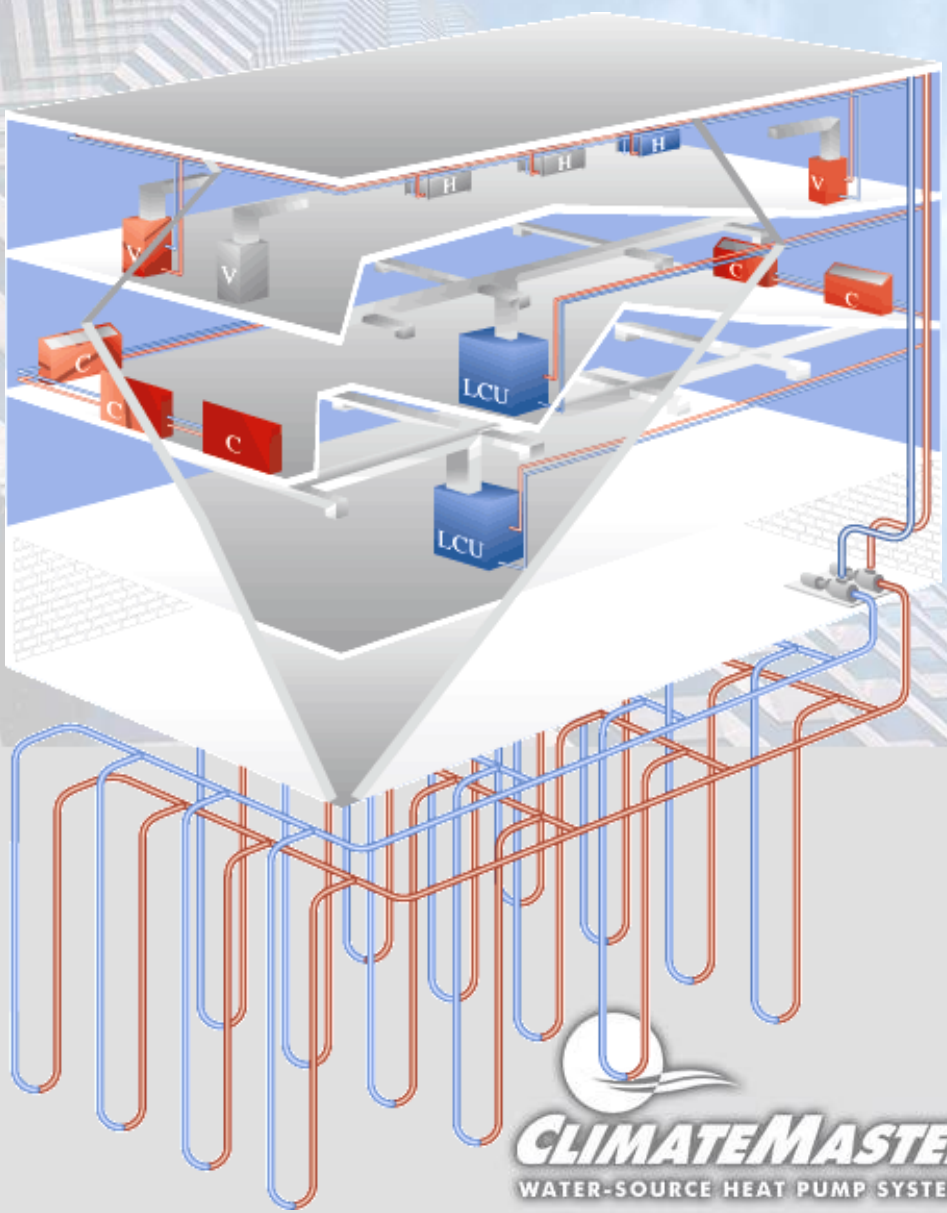
WATER-SOURCE HEAT PUMP SYSTEMS

Commercial Pumping Options



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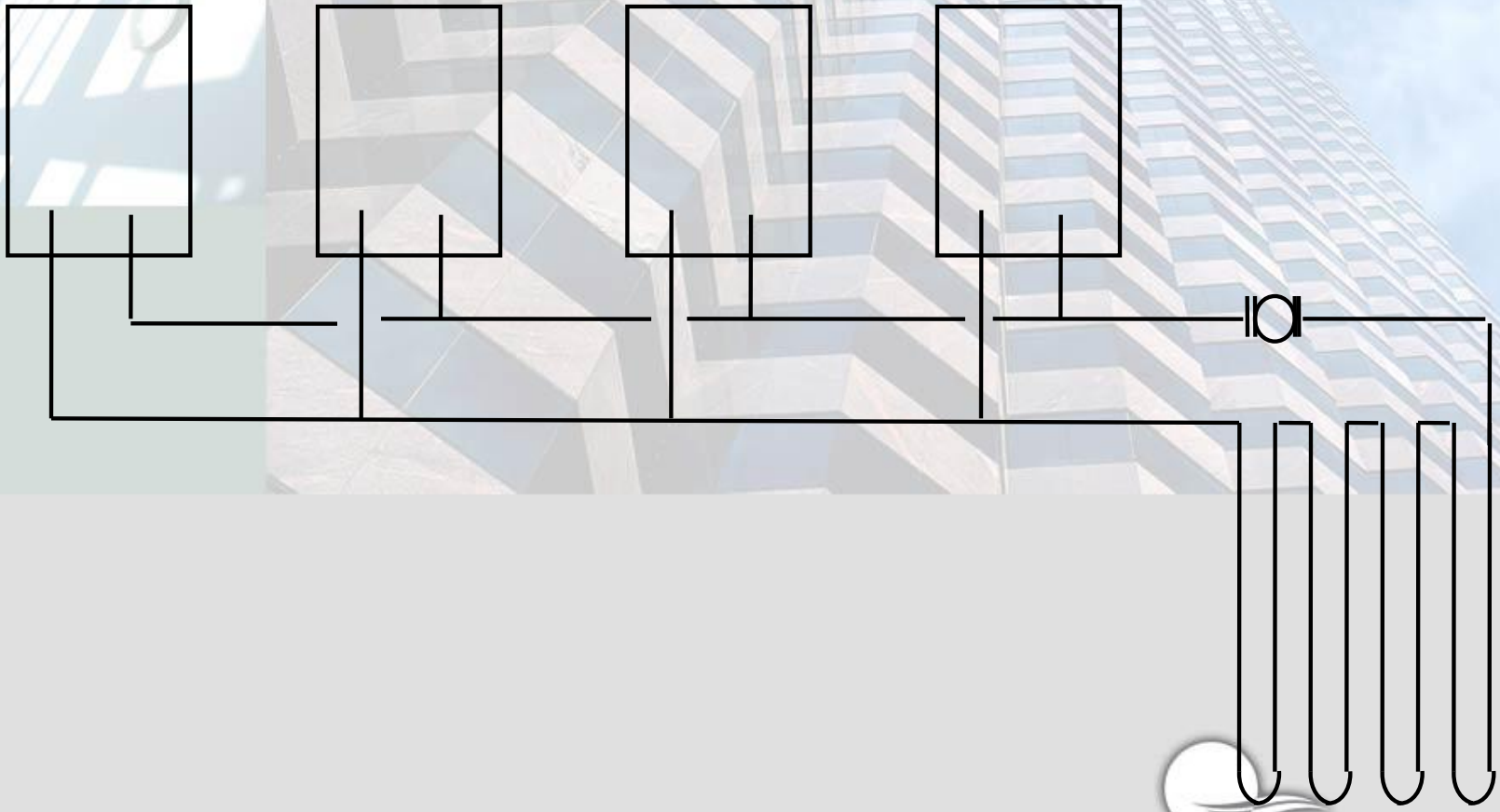
Central 2-Pipe Constant-Speed



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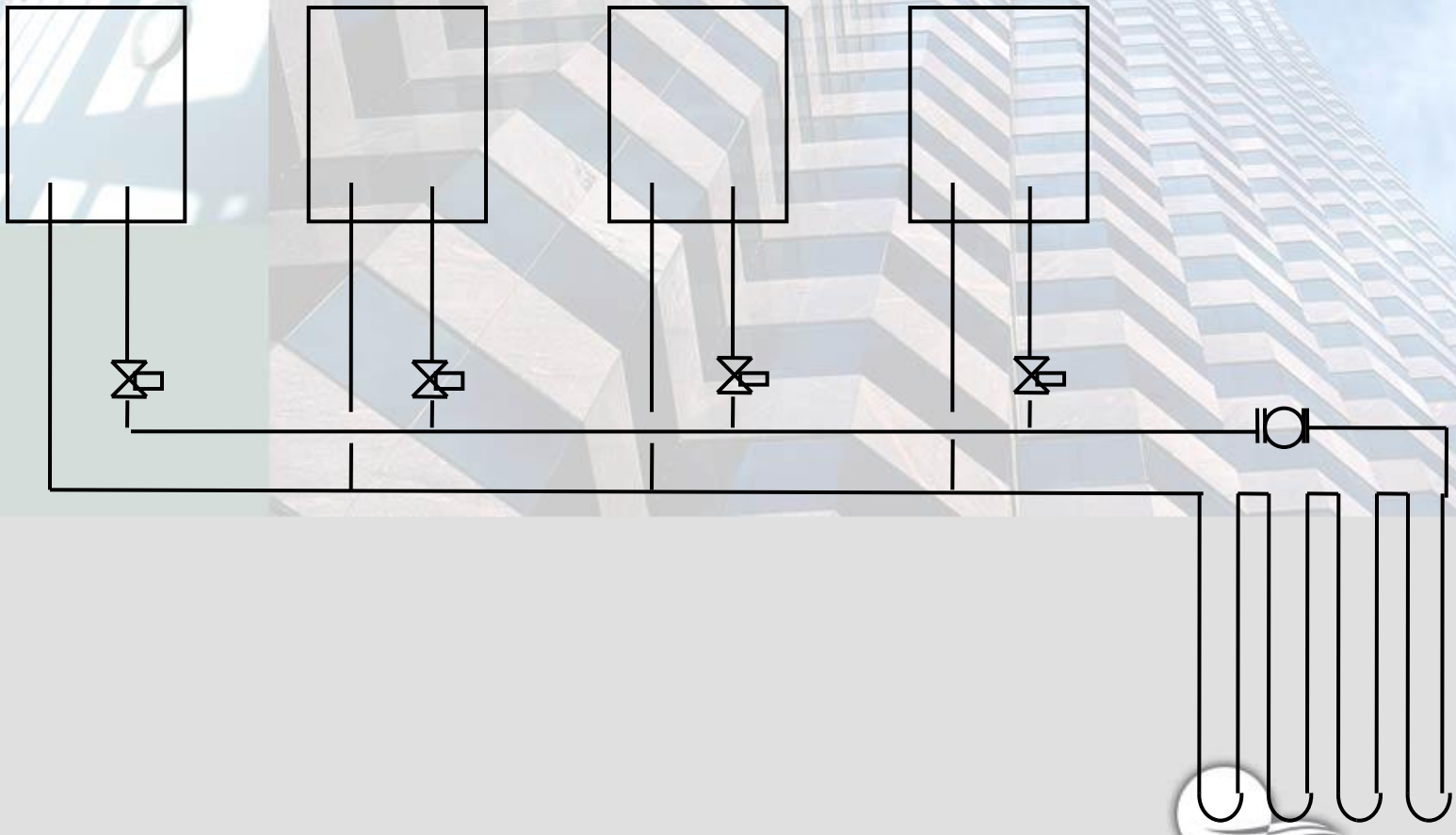
Central 2-Pipe Variable-Speed



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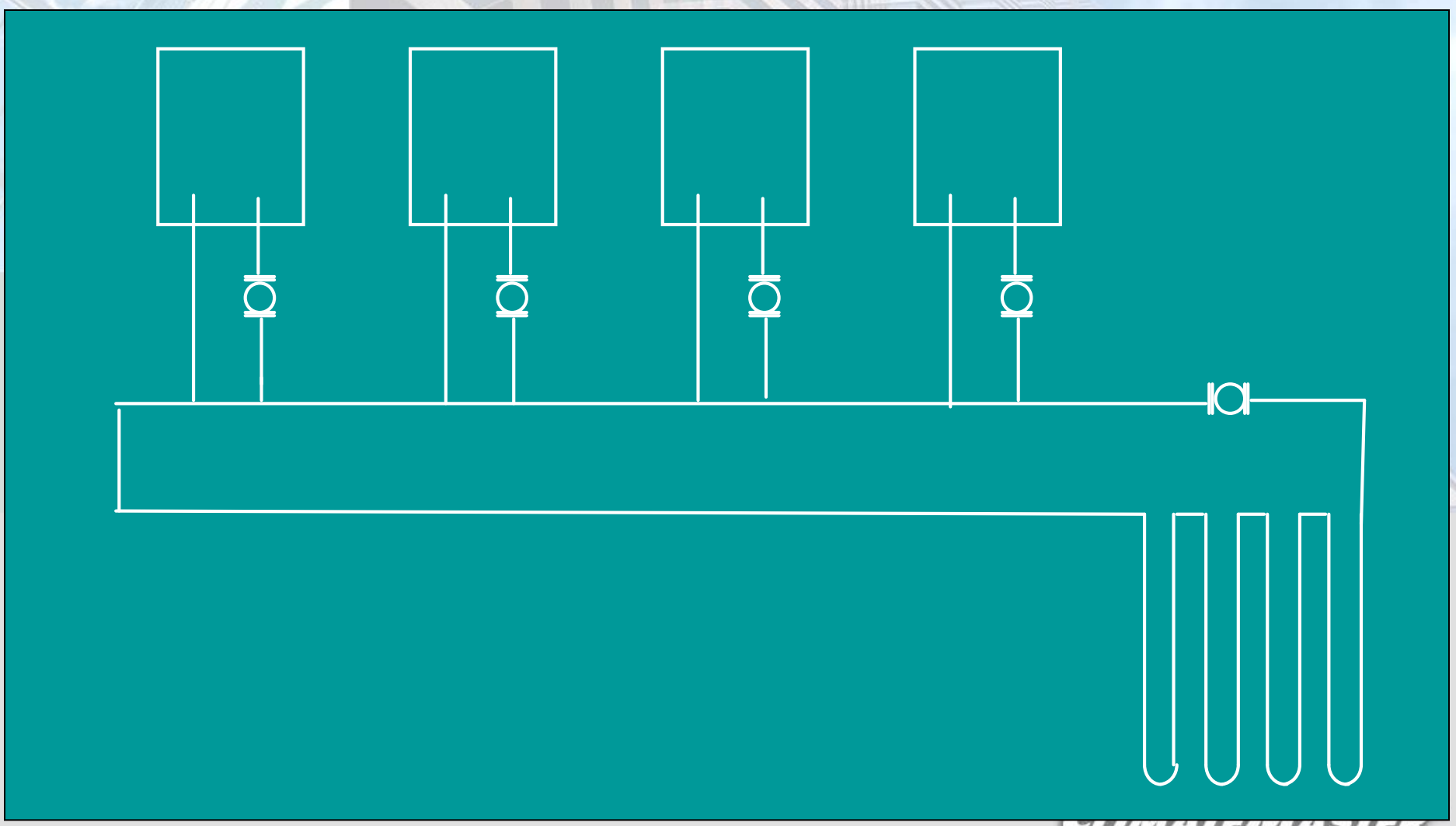
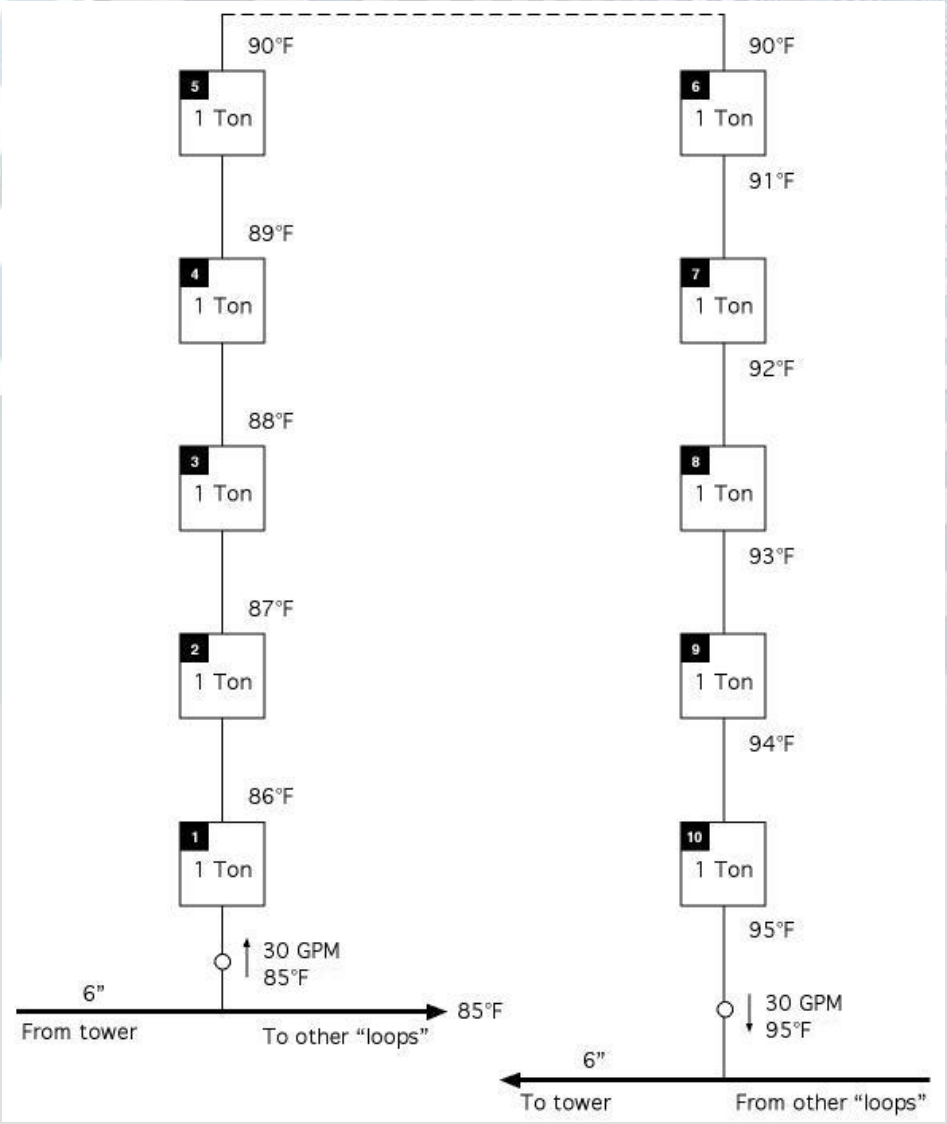
Central 1-Pipe Distributed



Single Pipe System



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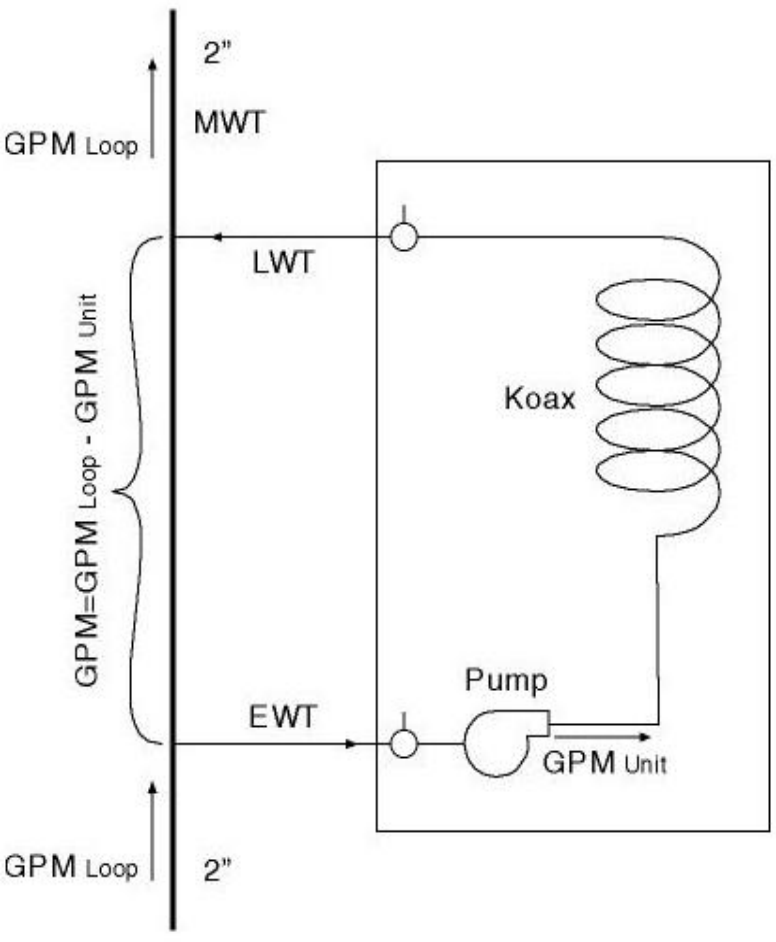
Single Pipe System



- Individual unit schematic flow layout

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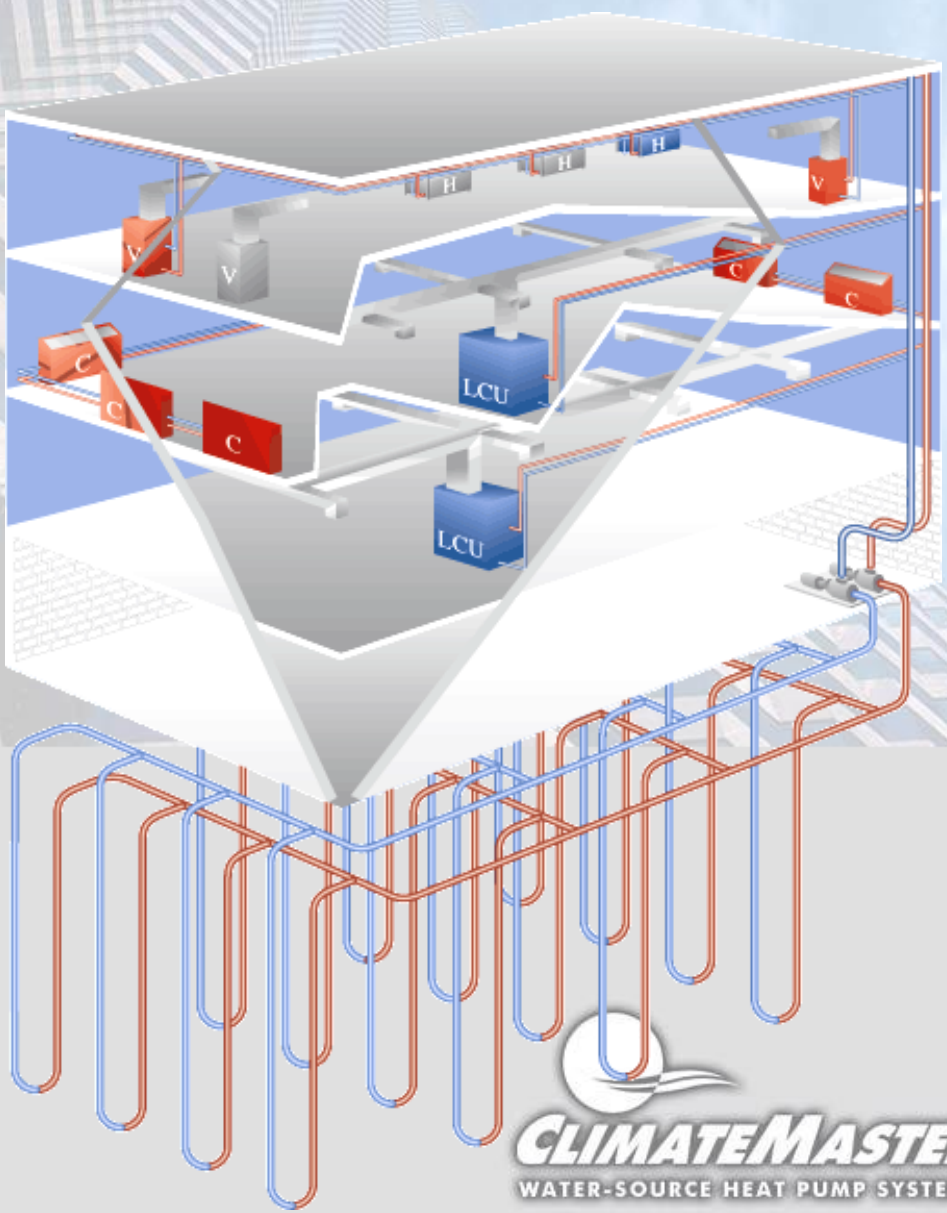
Unique Field Case Study



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WATER-SOURCE HEAT PUMP SYSTEMS

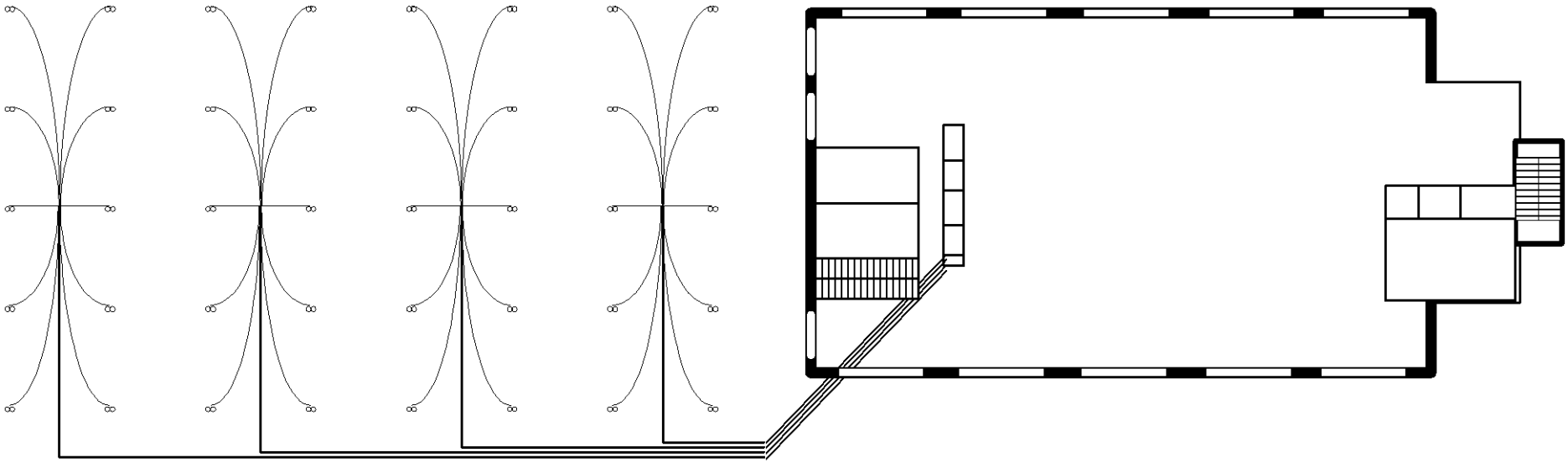
Garrett Office Buildings
Edmond, Oklahoma

Geothermal Building
20,000 Sq. Ft.

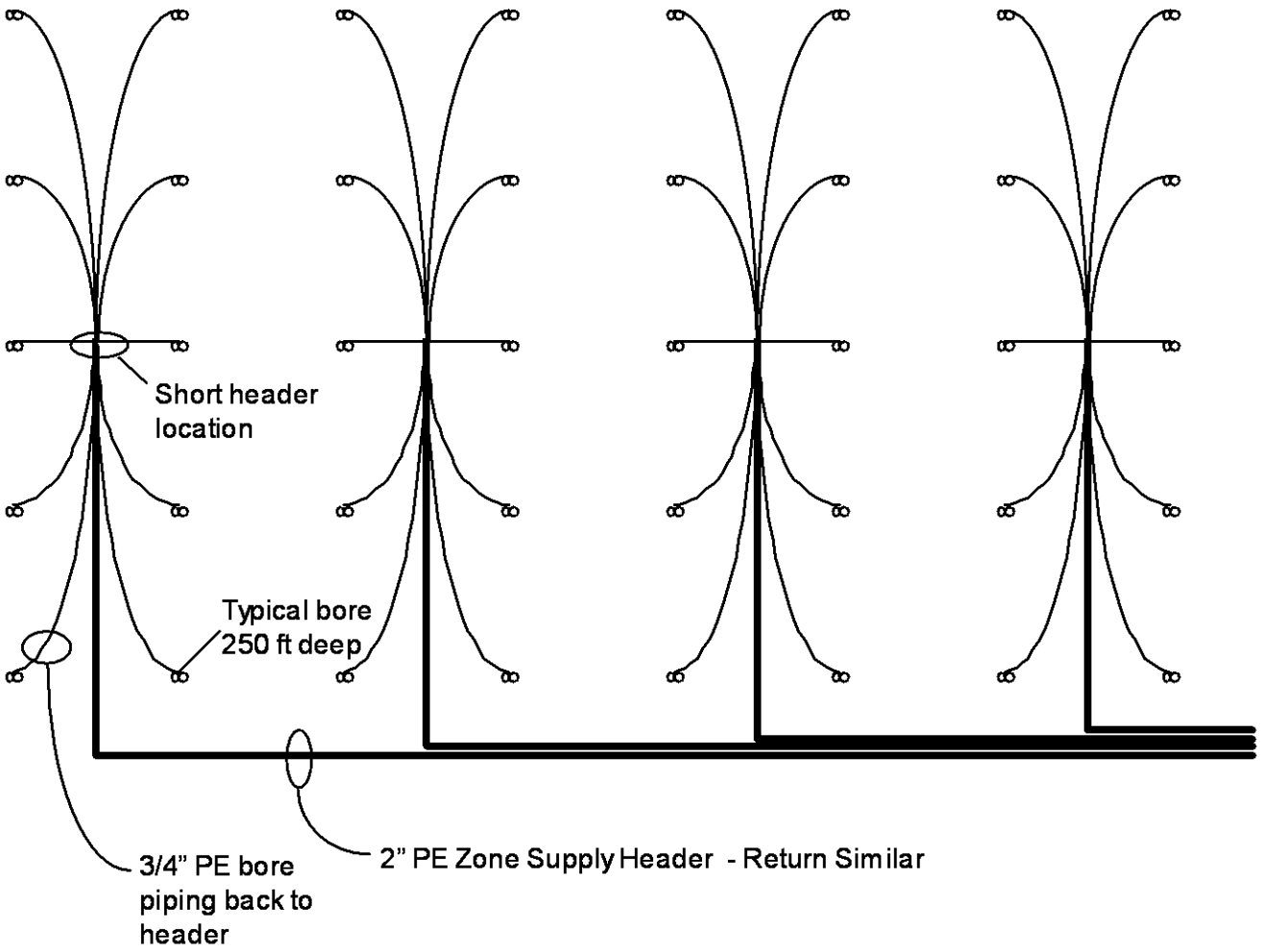
VAV Building
15,000 Sq. Ft.

Loop Field Overview

Geothermal Building
Loop Field Site Plan

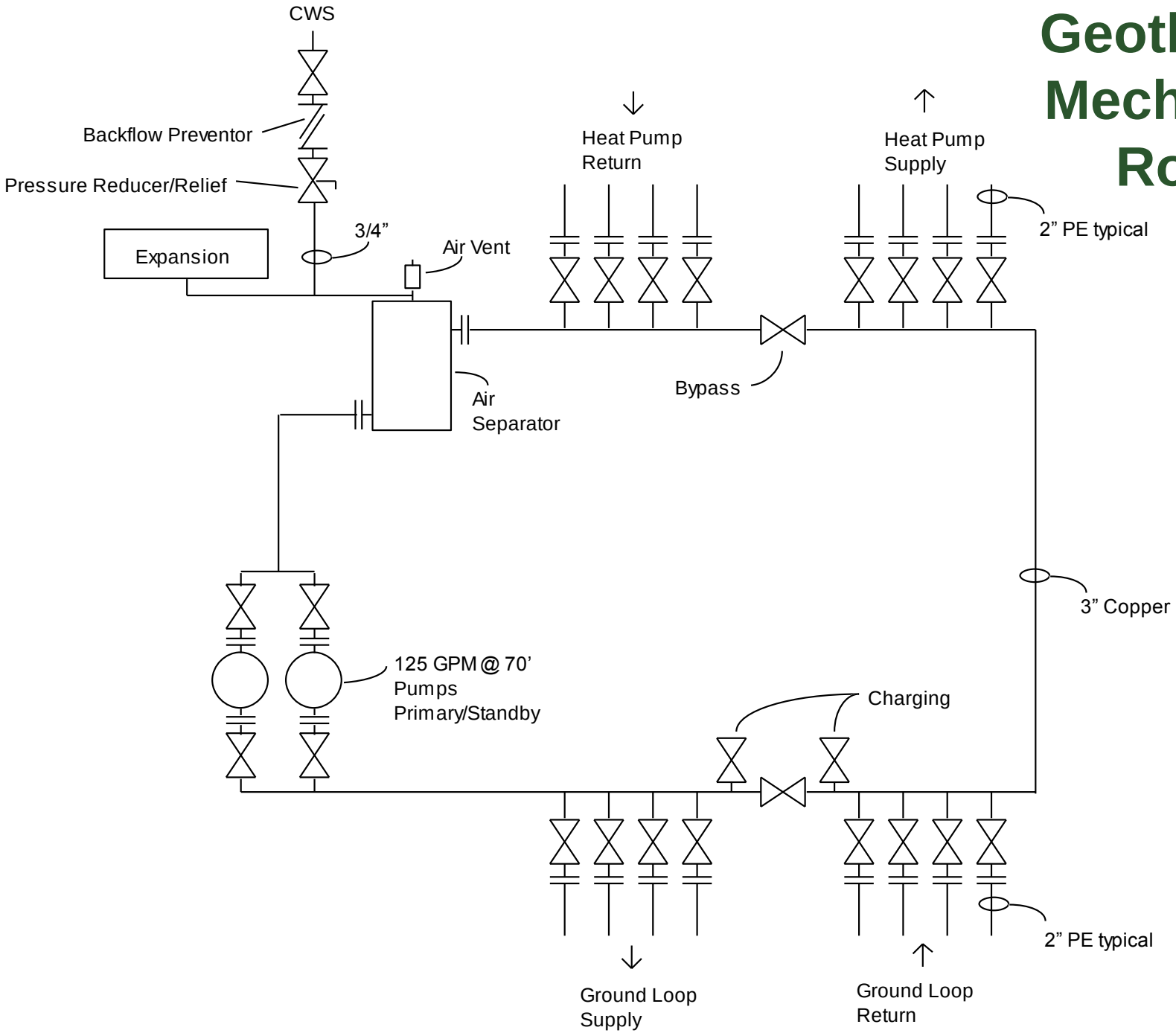


Loop Field Details



Notes:
- 40 bores on 20 foot centers each with 3/4" PE pipe
- Short header manifold in center of each loop zone of 10 bores
- Each bore must have the same overall pipe length for balanced flow
  (Coil excess piping in the header trench)
- Loop zone supply and returns done in same fashion
- Bores must be grouted when completed

Geothermal Mechanical Room



VAV Building
Roof View

VAV Building
Central Air Handler

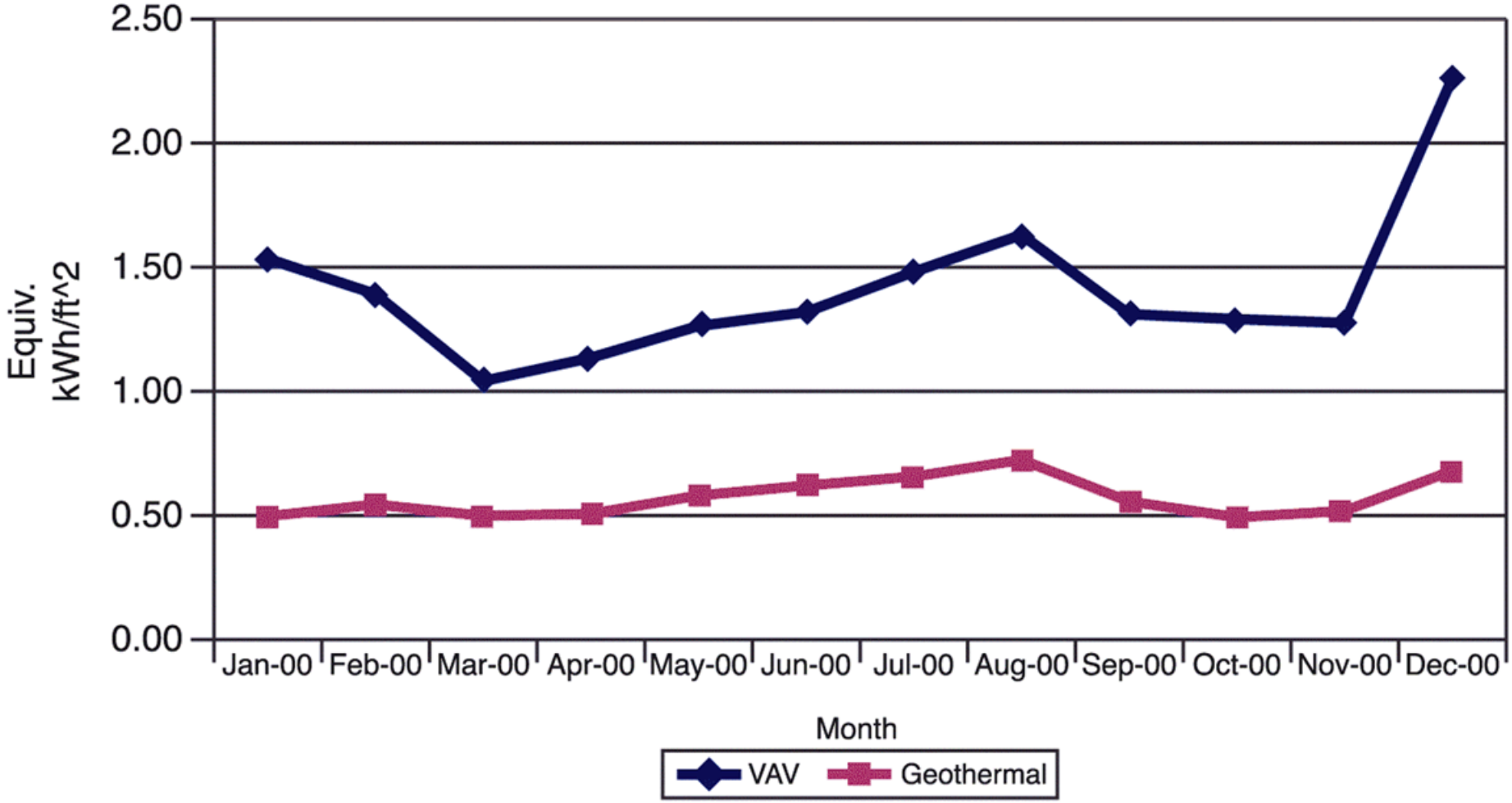
VAV Building
Air-Cooled Condensing Unit

Garrett Office Buildings

2000 Energy Consumption ($1.30/therm, $0.09/kwh)

Month	VAV 15,000 ft^2		Geothermal 20,000 ft^2	
	Gas Mcf	Elec kWh	Gas Mcf	Elec kWh
Jan-00	36.2	12,400	0.0	9,920
Feb-00	21.0	14,720	0.0	10,880
Mar-00	6.9	13,600	0.0	9,960
Apr-00	4.3	15,760	0.0	10,120
May-00	3.5	17,920	0.0	11,600
Jun-00	4.2	18,560	0.0	12,400
Jul-00	3.2	21,280	0.0	13,120
Aug-00	3.2	23,520	0.0	14,480
Sep-00	3.2	18,720	0.0	11,120
Oct-00	11.2	16,080	0.0	9,840
Nov-00	21.9	12,720	0.0	10,360
Dec-00	69.4	13,600	0.0	13,600
Total	**188.2**	**198,880**	**0.0**	**137,400**
$ Cost	**$ 2,447**	**$ 17,899**	**$**	**$ 12,366**
$/ft^2 & Total	**1.36**	**$20,346**	**0.62**	**$12,366**

Garrett Office Buildings
2000 Energy Consumption Profile



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Questions?

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Thank You!

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